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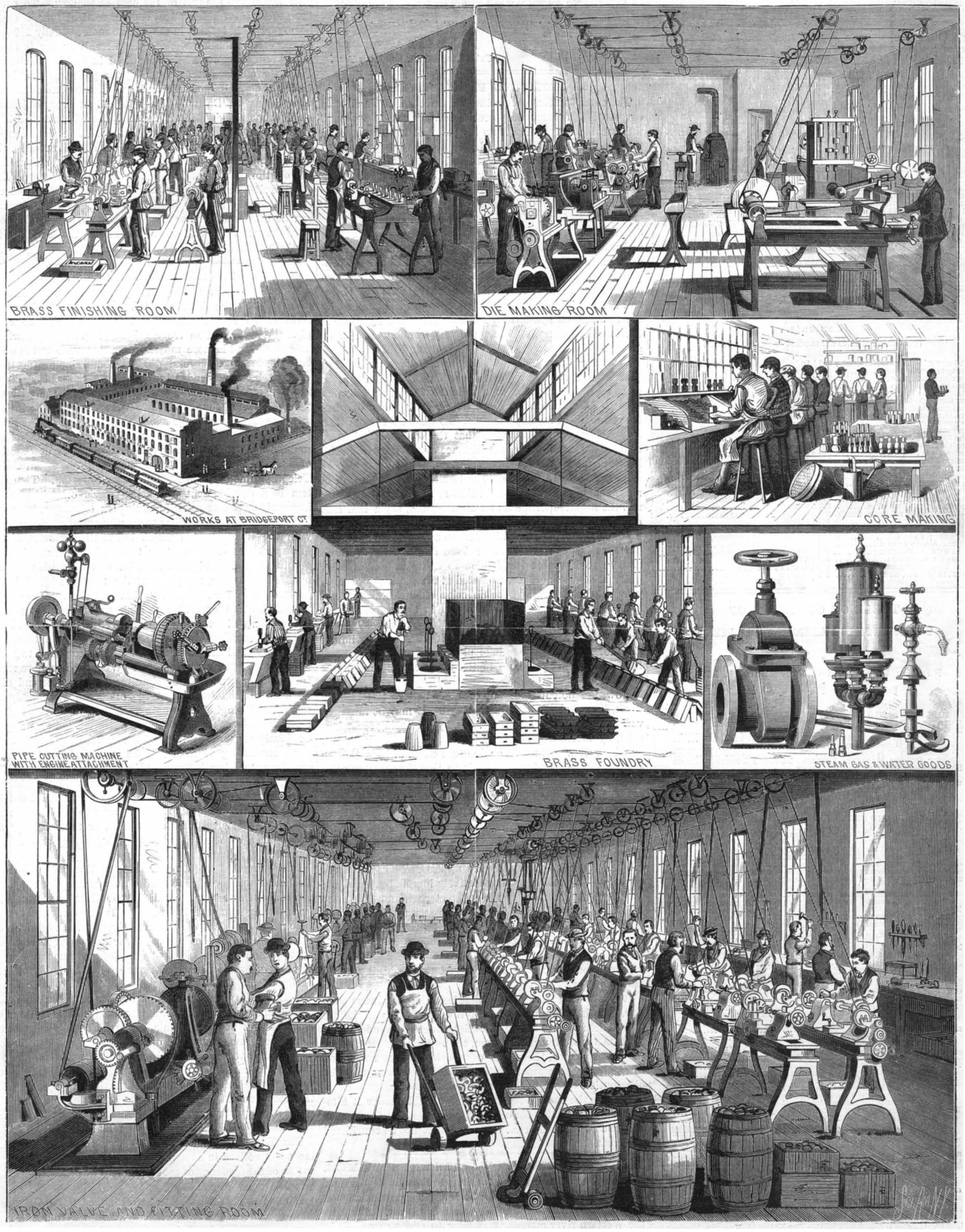

THE MANUFACTURE OF STEAM, GAS, AND WATER FITTINGS AND TOOLS.—EATON, COLE & BURNHAM CO.

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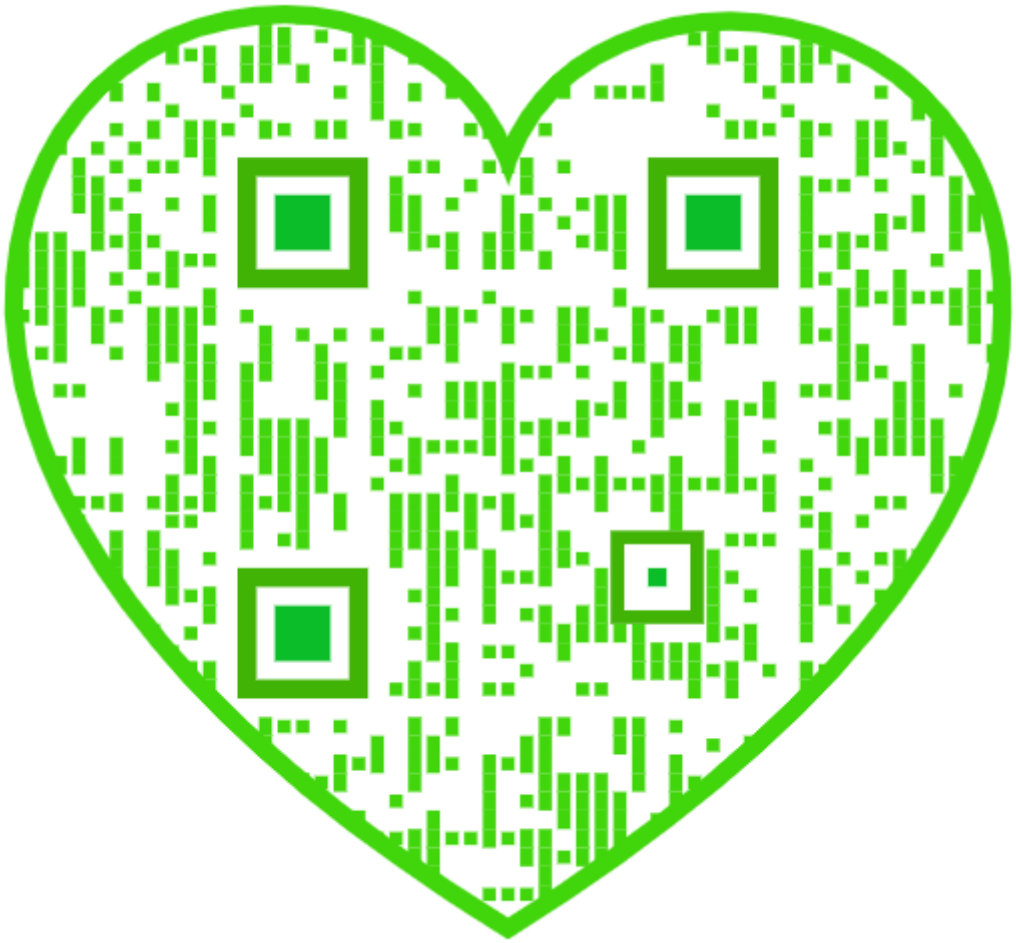

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ON PROTECTION FROM LIGHTNING.

The condition that determines the direction of an electric current is difference in potential between the two points, the current always being from the point of higher potential to the point of lower potential.

Upon the surface of the earth and within it electricity is constantly being generated by various means: by the friction of the wind upon it, by running water, by heat at the junction of two dissimilar substances, by magnetic disturbances, and so forth. The electricity so generated is quickly distributed to points of lower potential, and the whole is ultimately metamorphosed into that molecular vibration called heat. Let an ordinary magneto-telephone be properly attached to a wire a hundred feet long, and the two ends of the wire be stuck into the earth almost anywhere, and the ear may detect the presence of electric currents by the well known sputtering sounds. These are called earth currents, and sometimes they are very troublesome in telegraphy.

Professor Trowbridge, of Harvard College, found last summer that the ticking of the observatory clock could be detected at the distance of a mile from the line wire that goes to Boston furnishing the time service, and this when the terminals of the experimental line were no further than fifty feet apart. This shows that the observatory battery charges the earth for a great distance every time the circuit is completed by the seconds pendulum.

Suppose now that the positive terminal of a battery or of a dynamo-electric machine should be grounded at any place, and the negative terminal at a distant place, say a half mile or more away, the developed electricity would charge the first place to a potential higher than any other neighboring place, and a charged thunder cloud immediately overhead could not discharge itself there so easily as at any other place at a distance, for, as stated at first, it is *difference of potential* that determines the direction of an electric current, and the difference of potential is less in this supposed case than elsewhere. If the potential could be raised as high as that developed in the cloud, it would be absolutely impossible for any discharge to take place between the cloud and the earth at that place, no matter how near they might be together.

Now, the potential of any ordinary battery is relatively weak, but whatever its source may be, it may be raised in various ways: by providing points, by employing secondary coils, by increasing the resistance in the primary circuit. In whatever way it might be done the effect of induction by the cloud would be lessened by it so that the reaction upon the charged cloud would be either to necessitate the discharge at some other place where there was a greater difference in potential, or else to delay it until the potential had been raised still higher, which would only make it still easier to strike elsewhere. The evidence gathered from places where lightning has struck seems to indicate that the conditions which determine the stroke are comparatively trivial. For instance, a comparatively low limb upon a tree may be struck instead of the topmost part, and it is here argued that the charging of the earth at a given place with positive electricity may be a suffieient guard against lightning stroke, while at the negative end of the circuit it would be more likely to strike than elsewhere. This end of the circuit could be so arranged that lightning could harm nothing.

It is also taken for granted that lightning is always positive, and that all appearances of the so-called up stroke are optical delusions. The source of lightning in a thunder cloud appears to be always the same, the so-called latent heat of the watery vapor, the energy of which must be accounted for, and where the precipitation is rapid there is no time for distribution by convection or by conduction.

Perhaps the cost of such a method would render it altogether impracticable for ordinary buildings, but for powder magazines, oil tanks, etc., the cost might not be considered too great.

THE ELECTRIC LIGHT ON WESTERN RIVER STEAMERS.

From present indications the electric light is destined to play an important part in inland navigation, particularly on the tortuous rivers of the West and Northwest. As a rule the Western river men are very slow to adopt new ideas in their profession, but within the past few months the electric light has been affixed to some of the finest steamers on the Mississippi and Ohio.

The first boat to adopt the light was the Reuben R. Springer, plying between Cincinnati and New Orleans, and to-day the list includes the S. H. Parisot, the Natchez, the C. P. Chouteau, and Golden Crown, on the Mississippi; the Scotia, on the Ohio; and the towboats Iron Age and Iron Duke, plying between Pittsburg and St. Louis; also the towboat Harry Brown, described some time since in these columns, and engaged in coal towing between Pittsburg and New Orleans. Other steamers will shortly be fitted with the new light. In most cases a single light is used, of 1,500 or 2,000 candle power, and located at the forward end of the cabin deck. The carbons are placed in a movable lamp, similar to a locomotive "headlight," whose reflector projects the rays to the point desired, keeping the pilot house and the rest of the boat in shadow. To drive the generator an independent engine, vertical type, 8 or 10 horse power, is located in the engine room, usually 200 feet or more from the lamp. The main result so far is noted in the reduction of the time required in making landings. With the old cresset or "torch" the pilot was unable to land at the precise point desired, and backing and rounding was necessary. But with the electric light every object on shore is clearly defined in the darkest night, and the boat touches the shore just where desired. The handling of freight is also facilitated greatly. In actual running, the Western pilot as yet refuses to tolerate the light, and prefers the old time guides of hills and other landmarks. In fog also the electric light is pronounced useless. When steamers are fitted with two lights, the second is portable, and can be taken on shore or moved to any portion of the boat or of the "tow" of coal craft surrounding the steamer. In all these cases the Brush light is used.

THE HARMONIC TELEGRAPH.

Recently certain users of telephones along the line of telegraph between this city and Boston have noticed a novel addition to the assortment of sounds which telephone wires pick up by induction from neighboring telegraph wires. The new sound is more musical than welcome, and is obviously made up of several distinct tones singing together, while each is independently interrupted by rapid breaks or short spaces of silence. These breaks correspond with the "dot and dash" sounds of the ordinary telegraphic instrument, so that the message may be spelled out by the interruptions of the singing tone. Tracing these sounds to their source, they are found to be due to a relatively new system of multiplex telegraphy now on trial on the Western Union Telegraph line between New York and Boston. The system is a development of Elisha Gray's original electro-harmonic or electro-acoustic multiplex telegraph, the early history of which is familiar to all who are at all acquainted with the investigations which led to the invention of the first speaking telephone. The tones of the harmonic telegraph are produced by the vibration of steel reeds operated by electro-magnets, the pitch of the tone produced being determined by the number of vibrations the reed makes in a second. The current operating one reed, when passed over a line, will set in motion at the further end a reed exactly corresponding to the first in rate of vibration, and cause it to yield the same note, while a reed tuned to a different note is entirely unaffected. When two or more reeds are sounding separately or simultaneously at one end of a circuit, their counterparts at the other end will exactly respond, each singing or keeping silent as its corresponding vibrator at the other end of the wire is started or stopped. Obviously any interruptions of the current passing through any transmitting vibrator will be produced by its corresponding receiving instrument, but not by any other in the series, causing clearly recognizable breaks in the singing tone emitted by the vibrator. The message spelled out by such interruptions of the current may be read by the receiver in the interruptions of the tone, or the receiving vibrator may be used as a relay in operating an ordinary sounder.

In the practical work, on the Boston line referred to, it has been found possible to send simultaneously by one wire, and analyze at the other end, four distinct tones, thereby transmitting four separate messages in one direction at one time. This offers a signal advantage over the quadruplex system, which transmits two separate messages simultaneously each way, but cannot send four messages one way. In cases of extraordinary pressure of business the full capacity of the harmonic system may be utilized in either direction. It is hoped that the harmonic system will ultimately make possible the simultaneous sending of four or five messages both ways on a single wire; in other words, four tone messages and one ordinary Morse message in each direction, or ten in all. In this way all the tones of the octave will be made use of, and that is the probable limit of the system, unless it be found possible to operate with fractional tones.

RESPONSIBILITY OF EMPLOYERS IN GERMANY.

The Employers Liability Bill before the British Parliament was noticed in a recent issue of this paper as an indication of the tendency of modern law to throw especial safeguards around human life.

It appears that the practical working of the "Enforced Responsibility Law" in Germany, designed to make employers amenable for injuries received by those at work for them, has not proved altogether satisfactory. At any

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rate, Mr. Baare, Prussian Counselor of Commerce (and president of the celebrated Bochum Iron Works Company), has been called on by the government for suggestions as to its amendment; and has recommended a new law.

The old law, passed in 1871, makes railway companies responsible for injuries received by their employes in all cases in which the injury cannot be proved to be chargeable to "acts of God" or the personal carelessness of the party injured. The proprietors of mines, quarries, factories, and the like, on the contrary, are made responsible only when the injury is caused by the carelessness of the proprietor or his representatives. This restriction is held by Mr. Baare to be unjust, and he accordingly proposes a law under which any person in the service of another shall have the right to claim damages for injuries received in such service under any circumstances. The maximum damages to be paid to a laborer are fixed at $125 a year, or two-thirds of the usual yearly wages of a laborer. Men of higher grade, in case of injury, are entitled to two-thirds their usual yearly income.

These payments, however, do not come out of the employer's pocket. They are to be met from the funds of an insurance company, under the control of the German Empire, but supported by premiums paid annually by the employers, employes, and the community as a whole.

This arrangement, if carried out, would bring the laboring classes into close dependence upon the government, and Chancellor Bismarck is credited with the expectation that it would go far to check socialistic agitation. To an outsider the plan seems in no way calculated to increase the manliness or thrift of the laboring class of Germany.

THE CORUNDUM MINES, MACON COUNTY, N. C.

These mines are situated on the Sugar Fork River, a tributary of the Tennessee, nine miles from Franklin. They are owned and worked by the Hampden Emery Company, of Chester, Mass. A considerable part of the ore is roasted for the purpose of more easily separating the corundum from the accompanying rock. When sufficiently burned, the ore is conveyed to the stamps, crushed, and carried by a stream of water into troughs to be washed. A portion of the ore is then jigged, the corundum settling on the bottom; the lighter stuff, rising to the top, is skimmed off. The richer ores are cleaned by simple washing. From the jigs the corundum is placed on a drainer, and when sufficiently drained is taken to the loft, spread, dried, and sacked. The corundum is then hauled sixty miles to Mt. Airy, a station on the Charlotte and Atlanta Railroad.

The first mine reached is an open cut. It is situated on a steep hill side, about one hundred feet above the mill. The vein, though quite irregular, appears to have a width of from three to four feet.

The corundum in this vein is inclosed in that variety of chlorite called ripidolite and jeffersite, associated with tremolite and spinel. The corundum occurs in both cleavage and crystalline form, the crystals often having perfect terminations, while many are transparent and constitute the true Oriental sapphire, ruby, emerald, topaz, etc. Among such gems have been found an emerald weighing 30½ carats, and a ruby weighing 10 carats.

Two or three hundred yards south, and apparently on the same vein, is another opening of about one hundred feet in length, from which about a one hundred tons of ore have been taken. Lying on the east side and running parallel with this vein is a continuous vein of beautiful light gray corundun in crystals, from the size of a goosequill to that of the finest cambric needle.

The corundum taken from this vein is so entirely free from foreign matter that it requires very little manipulation to prepare it for use.

At the top of the hill, and two or three hundred feet above the former is still another open cut, twelve feet wide and fourteen deep. In portions of this vein are found large bipyramidal crystals similar to those from the Carnatics in the East Indies. This vein appears to have regular walling made up of tremolite, and carries corundum, spinel, and nearly all the varieties of chlorite. Southwest of this and probably on the same vein as the last, is another mine which has been more extensively worked than any of the, others. The vein is sixteen feet wide, and is uncovered for a distance of ten rods. The rock is so far decomposed that it can without difficulty be mined with a pick.

A tunnel is run in the center of this vein to a distance of twenty feet; connected with this tunnel at the farther end is a shaft eighteen feet in depth. This tunnel and shaft was originally made for the purpose of drying the walls of the vein before removal. It is now used as an oven for drying and roasting the ore. The varieties of chlorite associated with the corundum contains water of crystallization and exfoliates when heated, rendering it more easy to separate from the corundum. Since the first opening of this mine more than six hundred tons have been taken out, two hundred tons of this since April 1, 1880.

HOT JOURNALS.

One of the most important cares of an engineer is to see to it that the various bearings of the machinery in his charge are smooth, of uniform surface, and rightly adjusted. This apparently simple duty frequently requires the exercise of his best judgment; it is not only necessary that the journal box surfaces be close to the journal, but it it frequently just as necessary that the journal boxes be prevented from accidentally approaching closer to the journal. In a steam engine under full head of steam the play of one-sixty-fourth part of an inch between the crank pin boxes and the crank pin may be sufficient to jar the whole engine; and yet, if the engineer in endeavoring to take up this lost motion, should accidentally overtighten the crank pin boxes, the chances are that a broken crank pin or pitman, and a knocked out cylinder head, will serve as an illustration of the union which is apt to take place between the crank pin and its boxes under such circumstances. Many an apparently unaccountable break in a revolving shaft has occurred from a defective bearing. Heavy shafting, carefully lined in hangers secured to the workshop ceiling, may for months run without any sign of heating; but a pile of iron castings, or other heavy weight, unequally disposed on the floor overhead, may cause just sufficient deflection to expose the revolving shaft to one of the most destructive strains, and cause one or more of the hanger bearings to heat. In machinery the wearing away of one of the parts may subject another part to destructive strain, and it generally requires the exercise of experience and judgment in the construction and handling of the machinery, in order to prevent the harm. Many tons of coal have been wasted and much wear and tear of belts and machinery caused by inattention to these defects. In steam engines especially the adjustment of the journal boxes requires close attention. The expansion of the journal by heat, the quality of the lubricant used, the condition of the bearing surfaces and the amount of pressure they will be subjected to, exclusive of dust, speed of revolution, etc., should be taken into account. In all metal there is more or less elasticity, and when one box of a journal is by means of its screw bolts drawn to the right position in regard to its journal, it should also bear solidly on the other box, in order to maintain the adjustment of the boxes to the journal; if this precaution is neglected, when the shaft is revolving the elasticity of the screw bolts appears to act to cause an approach of the boxes, thereby squeezing out the oil from between the bearing surfaces and causing them to heat or grind. It appears that the continuous motion in one direction of one metal in close contact with another, tends to produce a still closer contact and finally a union of the metal surfaces; the lubricating oil, by preventing direct contact of the metal surfaces, opposes this tendency, and the use of liners or equivalent means to prevent the improper approach of the journal boxes, aids the oil in insinuating itself between the bearing surfaces. It is surprising to watch the effect of a few minutes' grinding of a journal in its bearing. We have seen a twenty-horse engine, under full pressure of steam, brought almost to a standstill by the sudden grinding of one of the bearings of a shaft about two inches in diameter. It appeared that the shaft would have twisted off sooner than revolve in the defective bearing.

WORLD'S FAIR IN 1883.

The matter having been pretty conclusively settled that we are to have a world's fair in the city of New York or in its immediate vicinity in 1883, the next important thing to be settled is the location for holding it.

A committee has this matter in charge, and at its weekly meetings they have placed before them various suggestions as to available space to be had for the purpose, and propositions as to terms for its occupancy.

The city of Brooklyn claims to have facilities superior to New York for the requirements of the Exhibition, and in some respects its claim seems to be well based. The Prospect Park Commissioners have generously consented, we understand, to allow the Exhibition to be held within the limits of the park, which our Commissioners very properly refuse to permit in Central Park, New York.

The following from the *Daily Bulletin*, of this city, echoes the opinion of many of the leading citizens of both New York and Brooklyn:

"If we are really to have another World's Fair," says the editor of the *Bulletin*, "it seems to us Prospect Park, Brooklyn, all things considered, would be the best site that could possibly be selected. True, the charter restricts the choice to some location on Manhattan Island; but if everything is satisfactory in other respects, it is presumed there would be no difficulty in having that instrument modified accordingly. The tender of the park is certainly a very generous one on the part of our sister city, and its numerous advantages are apparent. It would preserve our Central Park from invasion, and place at the disposal of the Commission 'ample room and range enough' for every purpose of the Exhibition without costing them a dollar; and this, too, with excellent sewage and other sanitary arrangements complete. With abundant railroad facilities for the transportation of merchandise and visitors, good roadways and carriage drives, and one of the finest boulevards in the world, we do not see what other locality can begin to compete with it. The Fair, there, would also attract the vast multitude that in the course of the summer go to and from the near-by watering places on the sea shore; and that of itself is a basis of financial success, it seems to us, which ought not to be overlooked."

Beet Sugar Making in Delaware.

The new sugar mill of the Delaware Sugar Company, at Riverside, a short distance above Wilmington, has begun work. Last year the entire product of sugar beets in Delaware amounted to about 300 tons, but this season the company expect to obtain from three to four thousand tons of better beets than last year, the cultivation having been better understood. The beets already delivered are testing from 8 to 14 per cent of saccharine matter, and the company are paying from $3.50 to $7 per ton for them, and are working up about 50 tons a day. If they obtain the quantity of beets calculated upon, the product, under the new and improved process now in use in the new mill, will be about 550,000 pounds of raw sugar, 200,000 pounds of molasses, and 1,700 tons of pulp, which is now selling at the factory to farmers at $1 per ton. It is stated that some of the beets were allowed to remain in the ground too late in the season, and thereby were somewhat deteriorated for producing sugar. This, with other defects in the cultivation, will, it is said, be remedied the next season.

AN INVENTION WANTED.

In carrying out their laudable and highly promising efforts to introduce silk production as a domestic industry in this country, the Women's Silk Culture Association of the United States have discovered the need of a suitable hand reel for home use, and appeal to the inventive readers of the SCIENTIFIC AMERICAN to supply the need.

The economical production of cocoons is no longer a problem in this country. The worms thrive almost everywhere, and in every community are women and children who have plenty of unoccupied time which can be utilized easily and pleasantly in the production of cocoons. But silk manufacturers furnish no market for cocoons; they want reeled silk. The unwinding of the cocoons may be done in special establishments erected for the purpose; and were the silk growers sufficiently numerous to supply the requisite cocoons, such "filatures" would no doubt be provided, and so furnish a market for the cocoons raised.

As yet, however, the silk growers are too few and too scattered to support such establishments. Accordingly, it becomes necessary in the domestication of the silk industry to provide a simple hand reel with which those who raise the cocoons can also unwind them. The reel should be simple in construction, small and inexpensive; preferably of metal, as less liable than wood to be affected by atmospheric changes; and capable of turning off a warp answering the requirements of marketable silk.

Obviously a reel to meet the present demand will make for itself a much wider demand; since many who are now prevented from engaging in silk production by their inability to meet the demands of the trade for reeled silk, would doubtless engage in the work if the proper reel were provided. Our silk manufacturers are now, in the infancy of the business in this country, using $10,000,000 worth of raw silk a year. The association believe that the agriculturists of the United States will ultimately produce, nay, must produce this amount of raw silk, and more. They report that the industry is exciting a warm interest in all parts of the country, and that from every State in the Union there comes a plea for the establishment of just such a home industry. The office of the association is at 1328 Chestnut street, Philadelphia. Intending inventors should communicate with Mrs. John Lucas, President.

Death of "One of Nature's Gluttons."

The readers of the SCIENTIFIC AMERICAN will regret to hear of the death of the frog Rana Pipen, whose portrait appeared in this paper of February 7. He was found by Mr. Dan. Beard, November 17, dead in the glass globe that has been his home for nearly two years. The immediate cause of his death is supposed to be indigestion caused by the combined effects of supping upon two-thirds of a white perch and resting all night under the steam heater. His loss will be mourned by a large circle of friends.

RANA PIPEN'S MENU.

May, 14, one dozen "June bugs."
" 15, one full grown live mouse.
" 19, one leopard frog, one-third smaller than Rana.
" 24, large piece of meat.
June 2, 9 A.M., one full grown live mouse.
" 2, 1 P.M., " " "
" 5, one large piece of meat.
July 18, one live mouse, full grown.
" 20, one young alligator.
" 27, one live mouse, full grown.
" 29, " " "
August 9, " " "
September 17, one large brown bat.
" 20, one craw fish.
" 21, two "
" 22, one "
" 25, one live mouse, full grown.
" 27, " " "
October 8, " " "
November 15, white perch.
" 17, *dead.*

Convergent Squint.

Dr. C. A. Bucklin, in an article in the *Medical Record*, on the cause and treatment of squint, expresses the opinion that every squinting eye that is not due to paralysis of a muscle can be straightened. In convergent squint the use of one eye is usually lost; consequently its earliest symptoms should receive prompt attention. Dr. Bucklin has had the advantage of examining over two hundred cases of squint, and illustrates his text with a few of the more interesting ones to show the success that has attended the treatment which he therein recommends, that of tenotomy, or division of the tendon of the abnormally shortened muscle.

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AMATEUR MECHANICS.

HINTS ON MODEL MAKING.

It is a simple matter for an experienced instrument maker or machinist to produce a fine model with turned shafts, cut gearing, true pulleys, and smooth working cams, but it is quite another thing for an inventor, without tools or materials, to embody his ideas in a working model even though he may have a mechanical taste.

It is fair to suppose that every mechanical inventor in these days of cheap machinery possesses some sort of a lathe, as these indispensable machines are now made for prices within the reach of almost any one.

It is quite evident, from an inspection of the models of the Patent Office, that most inventors who undertake to make their own models expend a great deal of labor without corresponding results. In the matter of gearing, for instance, one will whittle his wheels in wood, another will borrow his gearing from some defunct clock, while still another will purchase ready-made wheels from one of our well-known firms making a business of furnishing parts of models.

Of the three methods of obtaining the gearing the latter is undoubtedly the best, as all that is necessary to be done, in case of the cast gear wheels, is to bore them and file up the teeth, and as the cut gear wheels are generally bored, the shaft may be fitted without further work on the wheels. It is, however, seldom absolutely necessary to use toothed gearing, as rotary motion may be readily transferred by suitable friction wheels or by grooved or sprocket wheels and a round belt.

Figs. 1 and 2 show a form of friction gearing which is both simple and effective. The larger wheel is simply a disk of sheet brass having rounded edges, and boss spun or soldered on, and a smaller wheel consists of two swaged disks of steel having their convex faces separated by a metal washer a little thinner than the large wheel. These three members are secured to a common boss by spinning the end of the boss partly over one of the disks, as shown in the sectional view, Fig. 2. This form of friction gearing is noiseless and runs strong enough for the requirements of almost any model.

Figs. 3 and 4 show a form of sprocket wheel which is readily made and is almost as positive in its action as gearing. In this case the two wheels are alike; they consist of disks of sheet metal nicked to a uniform depth from the edge, and the arms thus formed are bent alternately in opposite directions, forming a groove for receiving the round belt used in transferring motion from one wheel to the other. It is evident that a belt cannot slip on a wheel of this construction.

Fig. 5 shows a form of friction gearing for transferring motion at right angles, and for imparting a variable speed to a shaft from another shaft running at a uniform rate. The large wheel in this instance is merely a plane disk of metal mounted in the manner already described. The smaller wheel is a grooved metal pulley surrounded by an elastic rubber ring. This is pressed with more or less force against the metallic disk, and its speed may be varied by moving it toward or away from the axis of the disk.

As to the matter of irregular motion usually imparted by cams, it is difficult to make a cam in the ordinary way with the milling machine, and there appears no very simple way of cutting them from solid castings. There is, however, a simple way of building them up from readily obtained materials.

Fig. 6 shows a cam consisting of a cylinder of brass or a short section of brass tubing provided with two heads and mounted on a shaft. The cam groove is laid out on this surface, and two parallel pieces of square brass wire are soldered to the surface of the cylinder, or fastened by means of screws. They are placed uniformly distant throughout the entire circumference of the cylinder.

Fig. 7 shows a cam built up in the same way on the face of a disk.

As to shafts, the model maker may save himself much labor and expense by using Stubb's steel for small shafts, and cold rolled iron for larger ones. Either the steel or iron may be bought in one and three foot lengths.

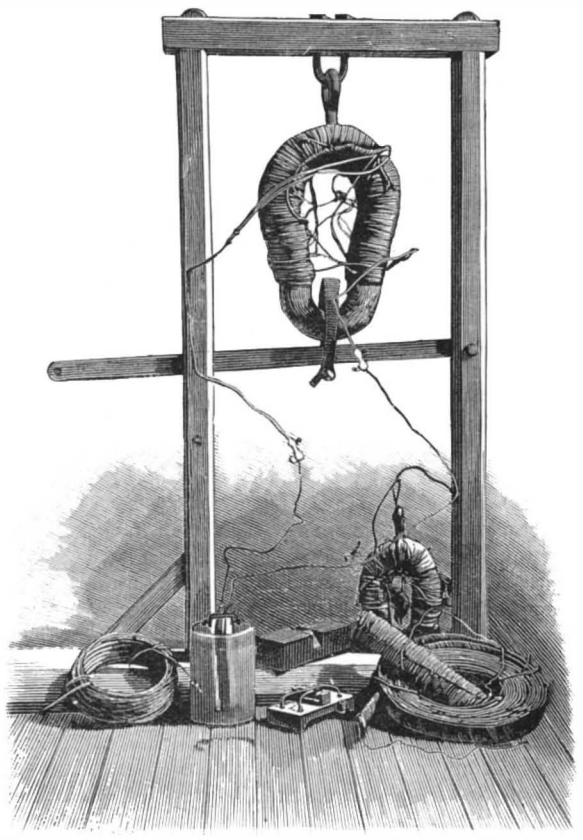
Almost anything in the way of parts of models may be purchased ready for use, so that all the inventor need do is to combine them and mount them on a suitable frame; but even so simple a matter as a wooden frame for a model sometimes proves troublesome.

The small tenons and mortises are difficult to make, and the frame to be strong enough to bear handling must be made so heavy as to be entirely out of proportion. A simple and easy method of securing the joints of small frames is to clamp the parts in the position they are to occupy in relation to each other, and then drill, with a sharp twist drill, two holes through one piece from side to side and into the end of the abutting piece, then inserting two hard wood pins, having previously coated them with glue. This makes a joint far stronger than the mortise and tenon, and it is very quickly done.

M.

PROFESSOR HENRY'S BIG MAGNET.

In the course of his pioneer work in the investigation of electro-magnetic action, William Sturgeon, of London, discovered in 1825 that soft iron could be rendered temporarily magnetic by surrounding it with a coil of conducting wire connected with a battery. As the result of this discovery he made the first step toward the construction of an electro-magnet. He bent a piece of iron wire into the form of a horseshoe, insulated it by a coating of varnish, and then



PROFESSOR HENRY'S BIG MAGNET.

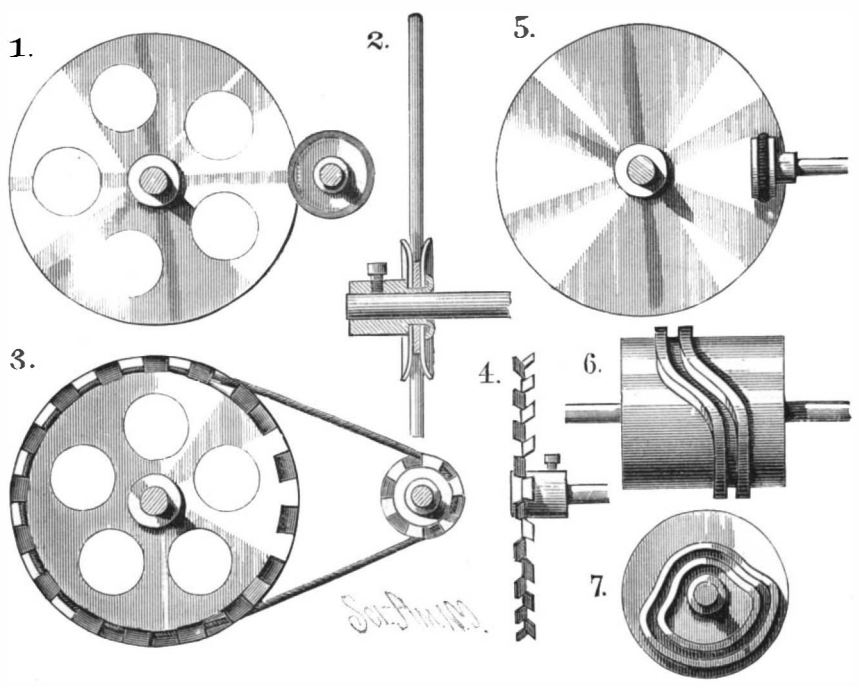
wound it with copper wire spirally, the spirals being widely separated, so that the current would be compelled to pass round and round the iron core. When the current was on the wire the core was found to be magnetic; when off, the core was not magnetic.

Professor Henry took up the discovery at this point and carried it an important step further. He wound the copper wire with insulating silk, making it possible to cover the core of the magnet with a much greater length of wire in closely wound coils, and also to lay on coil above coil. The compound helix so made developed great power, the same battery yielding with it a hundred times as much magnetic power as could be obtained with Sturgeon's arrangement. The first magnet on this principle was used by Professor Henry in 1828. It consisted of an iron bar two inches square and twenty inches long, bent, of course, into the form of a U or horseshoe, and wound with 540 feet of insulated copper wire in nine coils. The keeper weighed seven pounds, the core twenty-one pounds, and its lifting power was 750 pounds.

This magnet was used at Albany. In 1832 Professor Henry was called to the chair of Natural Philosophy in the College of New Jersey, at Princeton. Here he made two larger magnets for use in his investigations. One weighing 59½ pounds, and capable of sustaining 2,063 pounds, is now in the cabinet of Yale College. The other, made in 1833, weighed 100 pounds, and could support 3,500 pounds. It was many years before any magnet approaching this in power was constructed.

Through the courtesy of Mr. R. H. Rose, photographer at Princeton, and by permission of Professor Schanck, of the College of New Jersey, we are enabled to present an exact likeness of this historic instrument, as hung in the frame by which the inventor tested its strength. The magnet is deposited in the hall of the School of Science, one of the college buildings erected by the munificence of the late John C. Green. The coil at the right of the engraving represents the original silk-covered ribbon coil used by Professor Henry in his experiments on induction. The wire and battery at the left are modern, to show by contrast the improvement since made in the means for electrical investigation.

In the middle of the foreground is one of the pole-changers made and used by the professor. He was accustomed to delight himself and his classes with this by changing the polarity of the big magnet so quickly that a twenty-eight pound armature could not fall off, but was freed and reattracted to its place with a sharp snap.



TRANSMITTING AND CONVERTING MOTION.

Dr. C. O. Crosby.

A characteristically American inventor, Dr. C. O. Crosby, died in Brooklyn, November 15.

Dr. Crosby was born in Simsbury, Conn., and for a number of years practiced dentistry in New Haven. His natural bent was rather for invention, to which he early gave his attention. In connection with Henry Kellogg, of New Haven, he invented a machine for making ruffles and another for making pointed tape trimming, creating thereby a new industry from which he acquired a considerable fortune. Later he invented a machine for making fish hooks, a marvel of ingenuity; and afterwards a machine for making needles. These two formed the basis of a large business still carried on in New Haven. A machine for making pins was another of his notable inventions. Others were, a machine for making shoes, a machine for making tatting, and a machine for making cigarettes; all giving evidence of his wonderful versatility and inventive genius.

FROM the inquiries conducted by Prof. Hermann Cohn, of Breslau, since 1865, it appears that short-sightedness is rarely or never born with those subject to it, and is almost always the result of strains sustained by the eye during study in early youth. Myopia, as it is called, is seldom found among pupils of village schools, and its frequency increases in proportion to the demand made upon the eye in higher schools and in colleges. A better construction of school desks, an improved typography of text books, and a sufficient lighting of class rooms, are the remedies proposed to abate this malady.

One Hundred Bushels of Shelled Corn to the Acre.

Mr. Nathan G. Pierce tells the *American Cultivator* how he raises 100 bushels of shelled corn to the acre, having accomplished that feat for the second time this year. He uses for seed an eight-rowed corn which he has improved by careful selection, and believes it to be a good variety to raise in that locality, or, in fact, anywhere between Virginia and the Canada line, or east of the Alleghany Mountains.

The ground selected for planting was a good piece of gravelly loam. It was well plowed last spring, about the first of May, harrowed, treated to a broadcast application of 900 pounds fertilizer to the acre; again harrowed faithfully, rendering the land fine and mellow; rows marked three feet apart, a small amount of fertilizer scattered to each row. May 10th, three kernels of corn planted in each hill, two feet apart in the rows; cultivated and hoed four times, allowing no weeds to grow; passed through the entire piece, cutting each hill down to two stalks; every sucker in each hill cut throughout the field.

During the entire period of growth through the season the field was closely watched, every weed pulled and every ear of smut cut out. At the proper time, after the corn had become hard, it was cut, bound in bundles, and stooked. When dry it was drawn into the barn, where, with the assistance of a hired man, the corn was husked, weighed as husked, and found to yield 110 bushels of shelled corn to the acre, allowing seventy-five pounds of ears to equal one bushel of shelled corn.

WHEN, says the *Polyt. Notizblatt*, a few drops of ether or alcohol are let fall upon a paper equally moistened with cadmium and iodide starch solution, and the volatile liquids are set on fire, the paper will be found, after their evaporation, to be turned blue, owing to the formation of ozone.

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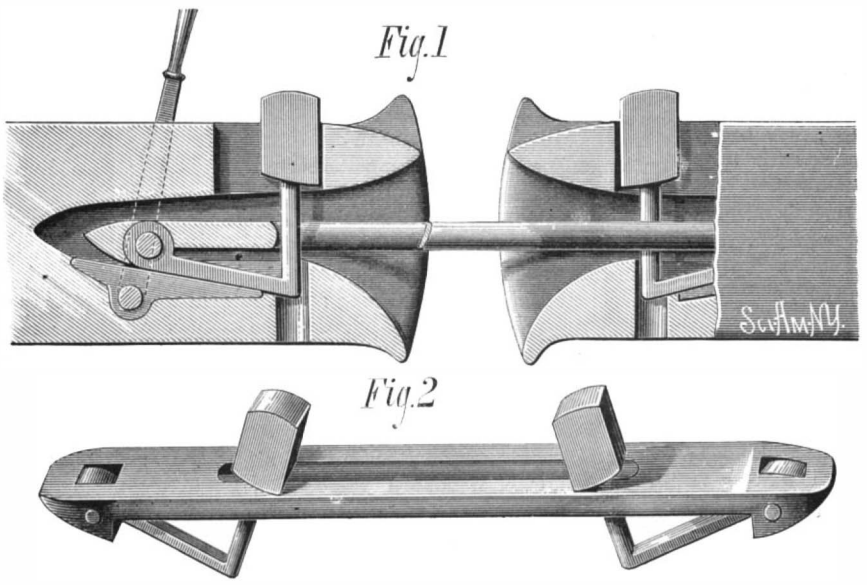
IMPROVED CAR COUPLING.

We give an engraving of a novel car coupling, which is automatic in its action, and is almost as simple as the common link and draw bar. It seems well adapted to freight cars, and may be used with advantage on passenger cars. The link or coupler consists of a bar of iron having in each end mortises, in which are pivoted the arms of drop bolts, which extend through a mortise in the middle of the bar. These bolts have large square heads fitfed to corresponding recesses in the draw head. The lower part of the bolt drops into a slot in the lower part of the draw head.

In the operation of coupling the cars the pivoted arm of the bolt acts as a guide to the link, and at the same time raises the bolt so that it enters the end of the draw head readily. When the link has entered the draw head far enough the hinged pin drops into its place and the coupling is secure.

To release the coupling, the hinged pin is raised by means of a short lever on the inner end of a rock shaft, which extends to the side of the car. Here the rock shaft is provided with a hand lever, by means of which the coupling may be operated. The hand lever is provided with a ratchet arrangement by which the uncoupling lever may be held in position to prevent the coupling from acting.

Fig. 1 shows the draw head in section, and gives the position of the link and of the uncoupling lever. Fig. 2 is a perspective view of the link detached from the draw head.



COPE'S CAR COUPLING.

It will be noticed that no springs or parts liable to get out of repair are used in this coupling. The inventor provides a pin with a square head, which may be used in this draw head in connection with an ordinary link.

We are informed that this coupling is in practical use on one of our principal railroads, and that it is indorsed by eminent railway engineers.

The invention has been patented by Mr. J. C. Cope. Dr. Fred Vernetti, of Montgomery City, Mo., is agent.

Test of the Mississippi Outlet.

The Dominion line steamer Montreal, bound for Liverpool, passed the jetties November 17, with the largest cargo ever taken from New Orleans. It consisted of 6,669 bales of cotton, 42,658 bushels of corn, and 2,000 packages of miscellaneous cargo, the total being equivalent in bulk to 9,565 bales of cotton.

NEW REFERENCE INDEX.

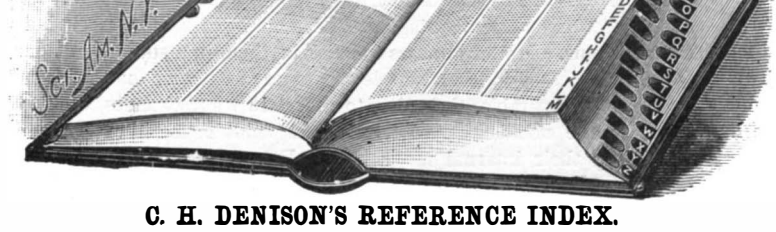
The engraving shows a reference index for dictionaries, directories, catalogues, Bibles, blank books, and all other books of reference.

With this index applied to a dictionary, directory, or any book alphabetically arranged, the initial letters of the entire alphabet are constantly visible, so that, whether the book is lying on either side or open at any page, the student can turn to any letter by a single motion.

As shown in the engraving notches are cut in the edges of the leaves so as to expose a small portion of the page on which each letter begins. On the surface thus exposed is pasted a facing of thin leather bearing the initial letter. The notches from A to M are cut toward the front, and from N to Z toward the back cover, thus forming two series. Now, when the book is lying on either side, the letters in the upper series, being closed downward, are hid, and when open at any place except between M and N, a *portion* of either one or the other series is hid. To obviate this difficulty and make the index perfect, each letter of the first series is duplicated on the margin of the front cover and on the margin of each leaf through to the notch containing the same letter. The letters on the leather facings or "pasters" in the notches are called primaries, and the marginal letters on the covers and leaves secondaries; and as will be readily seen, each secondary is directly opposite its corresponding primary. The primaries of the second series are duplicated in the same manner by secondaries on the back cover and leaves. If the book is lying with front cover up, and it is desired to turn to any word beginning with C, pass the finger under that letter on the cover into the notch under it, and the book is opened instantly to the position of the open volume in the cut. Here the primaries from D to M are still hid, but the corresponding secondaries are seen on the margin, each indicating that the notch directly under it contains the same letter, and the book is opened to any of them in the same manner as it was to C. Suppose now that the book is lying open in the position shown in the cut, and it is desired to open it to any of the exposed primaries, place the thumb on the primary, then grasping the adjacent cover or leaves with the fingers, and the book is instantly opened to that letter.

In indexing Bibles, pasters bearing abbreviations of the books are employed, and only the primary feature is applied, since so many notches are necessary that the secondary feature is impracticable. The notches are colored with any desirable color, and the pasters commonly used are of black leather, with the letter or abbreviation in gold, so that the index proves an ornamentation rather than a blemish to the book. It is the only index ever devised that applies to the class of books above mentioned. It saves one half the time now used in thumbing books of reference, and will outlast the binding even of a leather-bound volume.

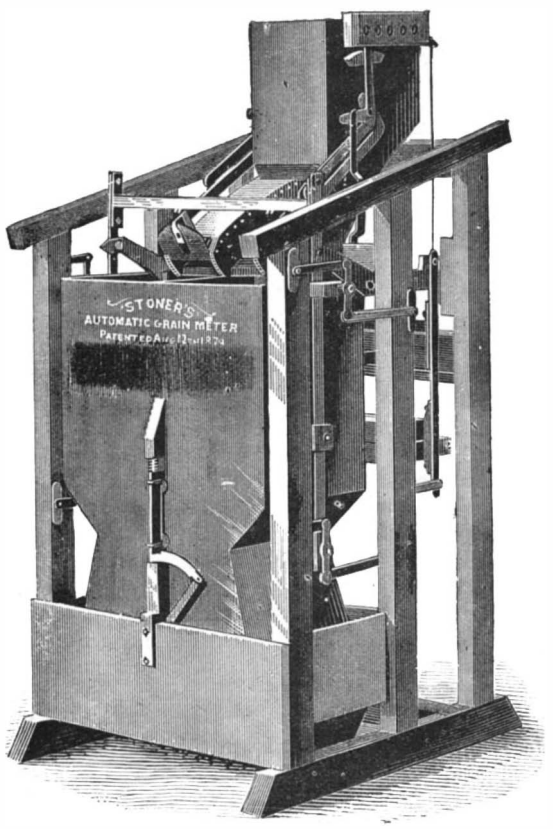
All communications in regard to this invention should be addressed to C. H. Denison's Index Office, 28 Bond street, New York City.



C. H. DENISON'S REFERENCE INDEX.

THE STONER AUTOMATIC SCALE.

Among the ingenious devices which have been attracting public attention at the American Institute Fair this year, the Stoner automatic scale, an illustration of which is here given, deserves especial attention. It is made under two patents granted to J. B. Stoner, August 12, 1878, and June 1, 1880. These scales are intended for use in warehouses, mills, and stores, or for putting up packages of flour, spice, corn starch, cracked wheat, or any dry substance that it may be desired to have in packages of uniform weight. They are made of different sizes, according to the work to be done, so that they will weigh from one pound to twenty bushels at a time. The twenty bushel scale will weigh at the rate of three thousand bushels an hour. The weighing is effected pound for pound, according to the weights shown on the scale beam, so that it is absolutely impossible for the machine to make a mistake, and it can only be operated by delivering the exact weight which it has been adjusted to give. At the Institute Fair it has been running for the purpose of showing its operation with cup elevators, which deliver the grain in a continuous stream into the scale; each time the receptacle in the scale has received the required weight, the grain is quickly tipped out, and the filling again commences, but as the grain is tipped out an automatic register records the fact, so that the work done for any particular length of time may always be known by a glance at the register. The machine is so simple in its details that it cannot possibly get out of order with any ordinary use, and it cannot make a mistake in giving exact weight and a true count.



THE STONER AUTOMATIC SCALE.

In the same section in which the automatic scale is shown may also be seen the pneumatic grain elevator patented by Mr. J. B. Stoner. This is worked by an exhaust, and, while it dries, cools, and cleans the grain, does away with all shoveling, saving four-fifths of the cost of that item, and will reduce the cost of annual insurance one per cent, from the fact that no machinery need be located in the warehouse, so there can be no fire from friction. It will also largely reduce the cost of warehouse building, as, with this system, no heavy framework is needed to bear heavy machinery.

For particulars in regard to both the above inventions apply to or address E. L. Hayes, 243 Broadway, New York. These inventions have also been patented in Canada, England, France, Germany, and Belgium.

RECENT INVENTIONS.

Mr. Alonzo J. Simmons, of Pana, Ill., has patented a novel mechanical movement for converting a rotary into a rectilinear reciprocating motion; and it consists in the combination of a shaft carrying a pinion with a peculiarly formed sliding block contained in a housing within which the block slides. This block is formed with an oblong groove and an elongated or elliptical gear on one side, with which the pinion engages, and with a straight groove on the other, which receives the tongue of another sliding block, which is connected to the object to be reciprocated, whereby a rotation of the shaft gives to the first sliding block a four motioned sliding action, and this in turn transmits a rectilinear sliding action to the second block.

An improved steam cooker, which is simple and in which any kind of food can be cooked thoroughly and rapidly, has been patented by Elizabeth Gallaher, of Bradford, Pa.

An improved polishing machine has been patented by Mr. Mervin R. Chase, of Warren, R. I. The object of this invention is to feed the polishing powder to and distribute it upon the polishing surfaces, to render the polishing surfaces by their construction and the peculiarly prepared polishing powder used upon them thoroughly pliable, pressing the polishing powder evenly upon all parts of the surfaces to be polished. The machine consists of two disks of yielding material having radial grooves in their adjacent faces. The polishing powder, which consists of polishing material and sawdust of cork is introduced through the center of the disks by means of a hollow shaft. The knives or other objects to be polished are introduced between the two disks.

Mr. William C. Marr, of Onawa, Ia., has patented an improved revolving scraper mounted upon wheels, which is so constructed that it may be operated and controlled by a person riding upon it or walking in its rear.

A glass ball trap with an automatically revolving arm and throwing spring has been patented by Messrs. James Kerstetter and John Fagley, of Kribb's Farm, Pa. The invention consists of a clockwork arrangement by which the arm and throwing spring are constantly revolved.

Mr. Edward Clark, of Brooklyn, N. Y., has patented an apparatus for recovering the sulphuric acid from the sludge acid from oil refineries in such a manner as to prevent any unpleasant or unhealthy odor from escaping, and at the same time obtain a sulphuric acid sufficiently pure for use in manufacturing superphosphates and analogous uses.

Mr. Carl Bush, of New York city, has patented an improved clay digger which consists in a blade or land side of a plow provided with a flange at the bottom edge and detachable mould board at the rear edge, to which blade a beam and a handle united at their lower ends are attached in such a manner as to form a runner which passes over the surface of the ground while the other parts cut into the ground.

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Meeting of Civil Engineers.

The 28th annual meeting of the American Society of Civil Engineers, adjourned from November 3, was resumed in this city, November 17.

The day's programme embraced the reading and discussion of the annual report of the secretary, John Bogart; a lunch at the office of the Engineer of the New York and Brooklyn Bridge, followed by an inspection of the plans of the bridge and the superstructure; a visit to the buildings of the Western Union Telegraph Company and the Equitable Life Assurance Company; an exhibition of the electric light in the last-named building; a ride in a tugboat around the Battery; a visit to the Erie Railroad elevator in Jersey City; a visit to the Hudson River Tunnel, and an evening meeting at the house, in Twentieth street.

The society lost by death during the year nine members: as follows: Thomas A. Emmet, John C. Thompson, I. M. St. John, Max Hyarlsberg, George W. Edge, Thomas S. Hardel, James A. Hayward, William H. Greenwood, and Arthur L. Ford.

At the evening meeting Mr. Craes, from a special committee appointed to collect data concerning the measurement of the flow of streams in times of freshets, made a brief report, in which he stated that the committee had received but few responses to their inquiries. Mr. O. Chanute said the problem presented to the engineer was how to increase the rainfall over that country known as the American Desert, in which the soil is abundantly rich to produce cereals, but where they could not now be grown on account of a lack of sufficient rainfall. Mr. Craes read an interesting paper prepared by Frederick S. Odell on the sewerage system of Memphis.

THE NATIONAL ACADEMY OF SCIENCES.

The fall meeting of the National Academy of Sciences closed on Friday, November 19.

Thursday's session began with the reading of two papers by Prof. S. P. Langley, "On the Thermal Balance" and "On the Measurement of Radiant Energy." In the first, Prof. Langley described at length the new instrument for measuring radiant energy, first made public some months ago. After nearly a year's experimenting he was able to present to the Academy a practically perfect instrument. In using the thermal balance a relatively powerful battery is employed, and the feeble radiant energy acts, not by its own weak force, as in the thermopile, but by controlling this great battery power, just as a weak human hand might control enormously greater power than its own when laid on the throttle valve of a steam engine. The thermal balance consists essentially of two series of delicate strips of excessively thin steel, platinum, or palladium, through which two equal currents pass. These opposite currents meet in a galvanometer, whose needle, pushed in opposite ways by two equally powerful forces, remains motionless. Warming one of the sets of strips by an almost inconceivably small amount would, it was shown, diminish the flow of electricity through the strips so warmed and alter the index. As little change as a fifty-thousandth part of a Fahrenheit degree could be thus detected, and what was important, the instrument was not only far more sensitive than the thermopile, but far more prompt and very precise.

Important applications of the new instrument in determining the distribution of heat in the solar spectrum were described in Prof. Langley's second paper. As is well known, in the spectrum formed by a prism the rays are unequally distributed, and part of the heat is absorbed by the material composing the prism, so that the distribution of heat in the spectrum affords no true test of the heating power of the differently colored rays.

In the pure spectrum of the reflecting grating, on the other hand, the rays are so dispersed as to make it practically impossible, with the instruments hitherto at command, to exactly measure their energy. For many years Dr. John W. Draper has held that the alleged threefold character of the solar beam as commonly taught, and supposed to be proved by the curves of heat, light, and actinic energy in the prismatic spectrum, was not true, the two halves of the spectrum divided by the ray of medium wave length being equal in energy. The complete experimental demonstration of Dr. Draper's position has been made possible by the thermal balance.

The exact conclusion of the research undertaken by him must, Prof. Langley said, be deferred. It was now clear, however, that the curves representing the distribution of heat and light in the spectrum were substantially coincident, and the statements of eminent European authorities, who had taken too little account of American men of science, as represented by such names as those of Rutherfurd and Draper, must be modified.

Prof. Elias Loomis, of Yale, followed with a report of his investigations respecting the "causes which determine the progressive movement of storms," the principal results of the investigation being as follows:

(1.) The lowest latitude in which a cyclone center has been formed near the West India Islands is 10°, and the lowest latitude in the neighborhood of Southern Asia is 6°. Violent squalls and fresh gales of wind have, however, been encountered directly under the equator. (2.) The ordinary course of tropical hurricanes is toward the west-northwest. In a few cases they seem to have advanced toward a point a little south of west, and in a few cases their course has been almost exactly toward the north. (3.) Tropical hurricanes are invariably accompanied by a violent fall of rain. This rainfall is never less than 5 inches in 24 hours for a portion of the track, and frequently it exceeds 10 inches in 24 hours. (4.) Tropical storms are generally preceded by a northerly wind, and after the passage of the low center the wind generally veers to the southeast at stations near the center, and the southerly wind, which follows the low center, is generally stronger than the northerly wind which preceded it.

"This fact appears to suggest the explanation of the origin of the cyclone and the direction of its progressive movement. The prevalent direction of the wind in the neighborhood of the West India Islands is from the northeast. Occasionally a strong wind sets in from a southerly quarter. The interference of these winds with each other gives rise to a gyration, and a fall of rain sometimes results. When rain commences the latent heat which is liberated causes an inflow of wind from all quarters, by which the rainfall is increased; and since the winds are deflected by the rotation of the earth, an area of low pressure is produced and the force of the winds will be maintained as long as the rainfall continues. The effect of this strong wind from the south is to transport the low center in a northerly direction, and by the combined action of the south wind and the normal wind from the northeast the center of low pressure is usually carried in a direction between the north and the west."

An important improvement in the Sprengel air pump was described by Prof. O. N. Rood, of Columbia College. After cutting off certain sources of leakage into the apparatus by means of mercury traps, he obtained a vacuum of one-sixty millionth of air atmosphere. Still finer results were obtained after the adoption of devices for withdrawing the moisture contained in the mercury used. In conclusion, Prof. Rood said that he had obtained vacua as high as the ninety-four-millionth of an atmosphere in some of his experiments, and in one had gone as high as one one-hundred-and-ten-millionth. There was no reason why higher results even than these should not be obtained, as it was merely a question of making the pump perfectly tight and excluding moisture. Prof. Crookes, of London, who has experimented in this direction, has reported his highest result as one-twenty-millionth of an atmosphere, and in France a distinguished experimentalist had recorded a vacuum of one-seventeen-millionth.

Prof. John S. Newberry, of Columbia School of Mines, read two papers, one on the "Antimony Mines of Southern Utah," the other on "Deposits of Crystalline Ores in Utah." Prof. Newberry regards Utah as one of the great mineral regions in the United States, and her mines of iron, coal, and antimony, to say nothing of the precious metals, as at no very remote date to attract an immense influx of population. He has prepared maps and a geological description of the iron, coal, and antimony deposits of the region south of Salt Lake, which were employed in illustrating his memoirs on these subjects, and are among the first accurate contributions to the geological knowledge of a tract of country whose mineral resources entitle it to rank as a profitable field for mining enterprise and capital.

The aggregate of iron in Utah he described as such as to throw into the shade all other known deposits in this country. He had seen enough lying loose during his short tour in the southern section of that Territory to keep all the foundries in the United States in operation for a hundred years. One of the most striking iron deposits upon which his eye had ever rested consisted of a group of hills, from 1,000 to 2,000 feet high, which were penetrated to a great depth with parallel veins of iron ore. As one crosses the valley of which these eminences formed a local boundary, they are identifiable from a distance of five or six miles as masses of metal. The type of metal was the magnetite, whose inky blackness of color gave the range the appearance of mountains of coal. One of these hills rose to a greater height than the rest, and in this the iron axis was disposed in strata as exactly parallel to each other as lines could be drawn upon the blackboard. While the prevalent ore in this region was magnetite, it was, nevertheless, interspersed with abundant masses of hematite; and there were many points where the two were intimately intermixed and blended. As one journeyed from point to point in this region the surface was found to be strewn with bowlders and broken masses of iron. He remembered such a mass about twelve or fifteen miles south of Iron City, which was 1,000 feet long by 500 broad and 200 feet high—a vast castellated crag of black magnetite.

Anywhere one might pick up vast masses of natural lodestone. The variety of structure was also surprising. Here was a mass as solid as cast iron; near by was a mass that was soft, decomposed, and stained blood-red. Within six to ten miles of this vast deposit of iron was an abundance of the best of coal to work it, so that one could stand on the brink of an iron hill and look down upon coal enough to convert it.

The first paper of the last day was a brief but important one by Prof. Henry Draper, on the "Photographing of the Nebulæ in Orion." After distributing copies of photographs taken by him, Prof. Draper said: The gaseous nebulæ are bodies of interest because they may be regarded as representing an early stage in the genesis of stellar or solar systems. Matter appears to exist in them in a simple form, as indicated by their simple spectrum of three or four lines. It is desirable, therefore, to ascertain what changes occur in the nebulæ, and determine, if possible, the laws regulating their internal movements. Drawings by hand have been made of some of the nebulæ, and especially of the nebulæ in Orion, for upwards of 200 years. But drawings are open to the objection that fancy or bias may distort the picture, and it is therefore difficult to depend on the result, and to compare the drawing of one man with that of another. To apply photography to depicting the nebulæ is difficult, because these bodies are very faint, and, of course, owing to the earth's motion and other causes they seem not to be at rest. They require a large telescope of special construction, and it must be driven by clock-work with the greatest precision. All such difficulties as those arising from refraction, flexure of the telescope tube, slip of loose bearings, atmospheric tremor, wind, irregularities of clock-work, foggy or yellow state of the air, have to be encountered. The photographic exposure needed is only an hour, and a slip or movement of a very small fraction of an inch is easily seen in the photograph when it is subjected to a magnifier.

In taking the photographs Prof. Draper used a triple achromatic objective of 11 inches aperture made by Clark & Sons, according to the plan of Mr. Rutherfurd, for correcting the rays especially for photography. This telescope was mounted on an equatorial stand and driven by a clock made by Prof. Draper. The photographic plates were bromo-gelatine and about eight times as sensitive as the wet collodion formerly employed. Having described the photographs, Prof. Draper remarked that a series of photographs taken at different seasons and in different years would make it possible to determine with some precision what changes, if any, are taking place in the nebulæ.

Prof. George F. Baker read a paper on "Condensers of High Potentiality," in which he described their construction and use. In measuring the insulation resistance of an underground cable about a year ago, a mica condenser, made by Elliot Brothers, of London, was used; the condenser was perforated by a potential of less than 200 volts. Correspondence with the makers showed that higher potential than 100 volts was never used on condensers in England. That potential produced no current through three and one-half miles of the cable insulation on a Thomson galvanometer of 5.011 ohms resistance; and even 1,000 cells (of 700 volts electromotive force) gave a deflection of only 35 scale divisions. Hence a condenser was constructed, insulated with the exceptionally high insulating material of the cable. This was found to stand the electromotive force of the 1,000 cells without difficulty. This insulating material, essentially a mixture of beeswax and rosin, therefore, has the first requirement—low specific inductive capacity—in a high degree. Paraffine, used to adulterate the beeswax, prevented high insulation; this was obtained only by using pure beeswax.

Desiring to use a condenser, upon the secondary wire of an induction coil giving a ten to fifteen inch spark, for the purpose of spectrum photography, Dr. Henry Draper suggested trial of one of the above condensers upon this circuit. This was constructed accordingly by R. P. Manly, of Philadelphia, and contained about 809 feet of tin plate, insulated by sheets of blotting paper soaked in the cable composition. On trial it was found to work admirably. Using the alternating current of a Gramme machine upon the coil, 2,400 sparks, three inches in length, were obtained from the condenser, with a noise resembling the fusillade of musketry. The potential here must be many thousands of volts; and the perfect action of the condenser shows the insulation to possess the second requirement.

There is no doubt that this form of condenser will replace entirely the Leyden jar for charges of high potential. It is compact and always clean; and it has the decided advantage that in case of its perforation it may be repaired by warming the composition. The perforations are filled up by the semi-melted mass. The production of such a condenser seems to furnish a new and ready method for determining the electromotive force of magnetic machines—a method more convenient than most of the methods now in use.

A paper on the "Ellipticity of the Earth," by C. S. Peirce, was presented by request of the Superintendent of the Coast Survey, and read by Prof. Langley. Prof. Peirce's observations have extended over a series of years, and have been conducted with appliances of extreme delicacy. Some of his conclusions are at variance with accepted doctrines. He finds, for example, that the correction hitherto made for the attraction of elevations is without actual foundation in fact. An island in the ocean, instead of making necessary a correction for its elevation above the general level, is without such influence as has previously been supposed on the vibration of the pendulum, and the same principle applies to elevations of other descriptions.

Lieutenant-Commander Sigsbee's gravitating trap for collecting organisms at different depths was described by Prof. Agassiz, who also reviewed the more important results determined by its use. It was found that to the depth of 50 fathoms the same organisms were taken as at the surface. The next 50 fathoms contained the same types, but the genera were less numerous. They counted 17 genera of pelagic organisms upon the immediate surface in one of these investigations, but only 5 of them were brought up when the trap was let down to a depth of 100 fathoms. Prof. Agassiz concluded with a high compliment to the ingenuity of Commander Sigsbee, whose invention had surmounted so many of the difficulties connected with the study of submarine biology.

He believed that the bodies of pelagic organisms brought up from great depth where the carcasses of animals that had perished of age or accident upon the surface, and had slowly settled to the bottom to furnish food for its liv

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ing hosts. It required from three to four days for a dead tunicate to sink to the depth of 1,000 fathoms.

The closing paper was by Prof. O. C. Marsh, "On the Brain and Spinal Cord of Some Extinct Reptiles." Referring to his previous paper on the same subject, and to the brain development previously enounced by him, Prof. Marsh called attention to the singular brain or brains of a gigantic reptilian of the jurassic formation which he had recently examined. This immense animal, though 30 feet in length, possessed a brain scarcely as large as that of an ordinary dog, as judged from the capacity of the brain cavity. But the most remarkable feature of its nervous system was an immense enlargement of the spinal cord in the sacral region, where the bone was so excavated as to form an immense vaulted receptacle, several times larger than the brain cavity. The sacrum consisted of four vertebræ, which were well ossified and of great solidity, and within this was contained, during the life of the animal, a posterior brain—if he might use the term—which was eight times as large as the encephalon. The point was of very curious interest, not only as a fact of fossil anatomy, but in respect to the physiological inferences that might be drawn from it, into which he did not propose to enter. It was so remarkable, indeed, that he took occasion to examine other examples of the same species before accepting it as a general fact of extensive application. Upon recurring to some younger specimens of the same gigantic saurian, he was enabled to verify the existence of the cavity in every instance, and to prove that sacral enlargement of the cord in extinct reptilians was an extraordinary fact. If it had appeared in a single instance, it must, of course, have been regarded as a phenomenon due to injury or disease; but in all cases since his attention was attracted to the point by this enormous creature he had found the posterior cavity in extinct reptiles.

There was nothing analogous to this sacral enlargement, Prof. Marsh continued, in existing vertebrates. The aurphiax had absolutely no brain—that is, no cerebral enlargement of the cord at the anterior extremity, but there was no enlargement of the spinal cavity at the sacrum which answered to what he had observed in extinct species. He would not take the time of his colleagues by drawing any conclusions from the facts he had stated. Prof. Rood inquired if the sacral enlargement was in such a position as to furnish a point of origin for the nerves of the leg. Prof. Marsh replied that such was the case, and that the creature had very powerful hind legs. But the fore legs were equally strong, and there was no corresponding enlargement.

AMERICAN INDUSTRIES.—No. 62.

THE MANUFACTURE OF STEAM, GAS, AND WATER FITTINGS, TOOLS, ETC.

The vast quantities and almost infinite variety of goods now required in this department, apart from the plain piping and other staple articles, render it especially appropriate that the making of these more difficult parts should constitute a branch of business by itself. The manufacture of cocks, valves, couplings, stops, etc., covers an almost endless assortment of varying patterns, and these, with the fittings and collateral articles, require an extensive variety of especially contrived tools and appliances, as well as the most skillful workmanship. Our illustrations on the first page of this paper represent the more important details of this branch of industry, as carried on at the extensive establishment of the Eaton, Cole & Burnham Company, at Bridgeport, Conn., where are made almost every description of steam, gas, and water goods, in cast, wrought, and malleable iron, as well as in brass, copper, and the related alloys.

The die making department is shown in one of the views at the top of the page. Here are made every description of screw threading taps and dies, with stocks adjustable or otherwise; also gas pipe reamers, drills, cutters, etc. A considerable proportion of the work done here is in the preparation of the working apparatus necessary in the other branches of the manufacture; but this is also the starting point for the making of a full line of tools for the use of gas, water, and steam fitters. The stocks and dies made are adapted to cutting threads on pipe of from ⅛ inch to 3 inches diameter, the dies being made either right or left, and fitted to work with a variety of different kinds of stocks.

The pipe cutter shown in one of the views, with engine attachment, is also furnished without such attachment, and of different sizes, to be used with either steam or hand power. The hand machine will cut and thread pipes of ⅛ inch to 2 inches inclusive, while the largest size machine will cut and thread pipes of 2½ to 6 inches diameter.

In the core making, which is shown in one of the sketches, only the most skillful hands can be employed in many of the specialties here produced. Cores are of sand or loam, sometimes also having a little straw or horse dung, and they are so moulded that they may be used as a part of the pattern, and in many cases to enable the pattern to be cast in a two part flask, where a three or four part one would otherwise be required. The core boxes used are of wood and metal, and for many of the goods, have to be made particularly for the work; the long cores are generally strengthened by wires or rods, but they will never bear much handling, and are carefully removed from the boxes and thoroughly dried in an oven for this purpose before using. When but little sand or loam is used in the core the latter is well burned, which consumes the small particles of straw, making them more porous, in consequence of which the castings are sounder, because the cores thus made allow of the free escape of air. In making cores for long pipes a twisted straw rope is first wound around an iron bar; this is then covered with a mixture of loam and horse dung, which is swept into cylindrical form by being revolved against the edge of a board, on which are cut the patterns of any interior rings or changes in size which are to be made in the pipe for each length of a core. This gives a straw core, through which the gases generated by the liquid metal may freely escape. In some cases, also, when the designs are complicated, the cores themselves are made in halves and placed together after being dried.

The core making is, of course, directly dependent on the pattern department, but the latter, as well as the iron foundry and forge shop, which are necessarily leading departments of the business, are not shown in detail in our illustrations.

The brass foundry, which forms the center view on the first page, is a capacious, well lighted, and well ventilated building. The variety of valves, cocks, and fittings cast here includes almost everything known to the trade in this department, and yet a great proportion of the work, though only in small pieces, is such as requires the greatest care and skill.

It is of prime importance in this work that the quality of the brass should be especially adapted to the uses for which the goods are designed, and in this particular the long experience and great variety of goods made by this company have been of great value. It is evident, for instance, that for engine work, and in many of the uses for which brass is required in steam fittings, a much tougher article is called for than in cases where the pressure would be greatly lighter or the wear far less severe. The ordinary commercial brass consists of two parts by weight of copper and one of zinc, though the proportions vary according to the experience of founders and the work in hand. A small percentage of lead is sometimes used, and this diminishes the ductility and increases the hardness, so that it can with greater facility be worked on the lathe. A tough brass for engine work is composed of twenty parts of copper to three of zinc and three of tin; while for heavy bearings a brass is made of thirty-two parts of copper to one of zinc and five of tin. Zinc, which is a good deal cheaper than the other elements, melts more quickly, and, if care be not taken, will burn off more or less before the metal is ready to pour.

The different components of the alloy which it is proposed to make are put together by weight in the crucibles, the furnaces in which the latter are placed are shown in the center. At the sides are the workmen preparing the moulds, and between them and the furnaces are the flasks containing the moulds into which the melted metal is to be poured. The most of the copper used comes from the Lake Superior region, which furnishes the best quality, and many of the alloys made here have stood the test of the severest use in proof of their adaptation to the purposes designed.

The brass finishing room, shown in one of the views, is fitted up with a great variety of improved machinery. There is a great deal of lathe work here, and there are many machines especially adapted for rapid finishing on goods of which the company make large quantities. Here the gauges and gauge cocks are fitted up, and the different styles of lubricators, valves, bibbs, nozzles, and couplings put together. The cutting of V-shaped and square screw threads and threads of varying pitch is also done here, and the assortment of tools with which the shop is provided for this purpose is so large that any demand for an article in common use can immediately be filled, if, indeed, it be not already made up in stock.

The iron valve and fitting room shown in the view at the bottom of the page illustrates the department in which the finishing work on all iron goods is performed. Here the double and single section radiators are set up, and the machine work generally is completed on all goods in either malleable, cast, or wrought iron.

In hydraulic and double extra strong pipe, in wrought iron pipes of many sizes, and in boiler flues, etc., the work done in this establishment covers every variety of goods in which thoroughly good workmanship, a high degree of skill, and the best of materials are indispensable requisites. A bare enumeration of the different articles produced makes an extended catalogue. It includes everything required by the gas-fitter—pipe tongs, vises, and proving pumps, fixtures and fittings; in the goods for steam work are patterns of feed-water heaters, gauges, steam traps, oil cups, and lubricators; in plumbers' tools and materials are the modern heating appliances, traps, water fixtures, etc., plain and plated; besides hose couplings, caps, pipes, and nozzles for fire department, mill, and factory use. It would, of course, be impossible that so extensive a line of goods could be produced except in an establishment which had grown into the business by the natural enlargement of its trade, but the company have kept pace with the growing demands by successive enlargements of the works at Bridgeport through many years, until now they have one of the largest and most completely fitted up factories in this line of industry in the world.

The New York office and warehouse of the company is at No. 58 John street.

The Atmosphere of Celestial Bodies.

M. José J. Landeur communicates an interesting paper to *Les Mondes* on the atmosphere of celestial bodies. Whereas previous investigations have given about 250 miles as the furthest result for the height of the earth's atmosphere, M. Landeur places it at not less than 22,000 miles. He corroborates his calculation by showing that the height at which meteoric matter becomes incandescent on approaching the earth is far beyond the distance heretofore assigned to it, and therefore there must be an atmosphere at that greater distance to produce the incandescence. He also accounts for the spectrum of the aurora borealis, showing a marked coincidence with that of the zodiacal light by the theory that since the earth travels in the zodiacal nebulosity from September to May, the rarefied atmosphere beyond the earth's heavy envelope of air must absorb some of the constituent elements of the zodiacal nebulosity, and thus these elements make their presence apparent in the spectrum of the aurora, which phenomenon occurs in this rarefied outer envelope.

M. Landeur believes also that the difference between the *observed* acceleration of the moon's mean movement and that obtained by *calculation* on any of the previously advanced hypotheses, which is very marked, may be wholly explained by the resistance of this nebulosity in the moon's movement.

The Sense of Colors.

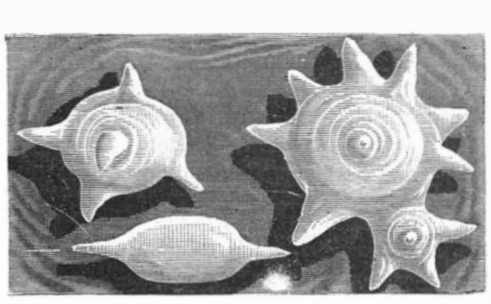
At the recent meeting of the French Association for the Advancement of Science, M. Charpentier, of Nancy, read a paper in which he propounded the somewhat novel theory that the sense of light and that of colors are independent. Since white light is the sum total of the various colors, it has been commonly thought that the sensation of white light was simply the sum total of the sensations of its constituent colors. On the ground that the sensitiveness of the eye for white light may be increased—as, for instance, by the previous absence of all light—without the sensitiveness for color being increased, he urges that there is a color-sense as distinct from that of light as is the sense of touch from the sense of heat.

Correspondence.

Shower of Angular Hailstones.

To the Editor of the Scientific American:

On the 1st of December, 1878, at 0:30 P.M., a remarkable hailstorm passed over Thymbra Farm, on the Plains of Troy, Asia Minor. A gale was blowing at the time from the southward, when a sudden massing of dark clouds flying in various concentric directions was observed. As the clouds passed over the farm there was a heavy discharge of hailstones, for the space of about five minutes, which whitened the ground with an icy covering. The hailstones were above the average size. The remarkable feature, however, was the extraordinary shapes these stones presented, some of which were round or irregular with angular projections, others flattened with but two of these points. Shapeless masses of ice also fell. The stones were whiter at the core than on the external portion. To account for this phenomenon, it may be suggested that the upper portion of the cloud was suddenly converted to snow, which, falling and gyrating in the lower, formed the nucleus around which the vapor was condensed and frozen; while a rotatory motion gave the round form to the body, or added to the spherical nucleus of the snow, the angular portions of the crystals increased in size. The delicate arrangement of the original hexagonal crystals of the snow was destroyed, which explains the various shapes and irregular number of angles in the hailstones. The drawing is made from a sketch taken at the time, which represents the natural size of the hailstones. Violent guests of wind, but no electrical discharge, accompanied the fall.



FRANK CALVERT,
U. S. C. A., Dardanelles.

MECHANICAL INVENTIONS.

An improved coffee pulper and separator has been patented by Mr. Edwin L. Henington, of Santaren, Para, Brazil. The object of this invention is to furnish simple and convenient machines for expeditiously removing and separating the pulp from the berries or kernels of the coffee fruit.

An improved car coupling has been patented by Mr. James Coart, of Harrisburg, Pa. This invention consists in improved means for supporting the coupling devices of a car, and in combining the parts that do the coupling with and uncoupling from the link.

Mr. Franklin H. Lummus, of Brooklyn, N. Y., has patented a cotton condenser, which may discharge the dirt accumulated in the pocket provided for it by being raised out at the bottom.

Mr. William Tucker, of East Toledo, Ohio, has patented

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an improvement in that form of coupling in which the bumper is formed with a hooked head and provided with a hinged jaw that engages with the hooked head of the adjoining car.

An improved tool for cutting plate iron has been patented by Mr. William T. Bennett, of Petersburg, Ill. This invention is more particularly intended for cutting pieces from steam boilers in order to insert patches, but it may be used for various other purposes. It consists in a cutting blade and a handle or lever and its fulcrum, and the combination and arrangement thereof with relation to each other, so that by operating the handle the blade will cut or saw the metal.

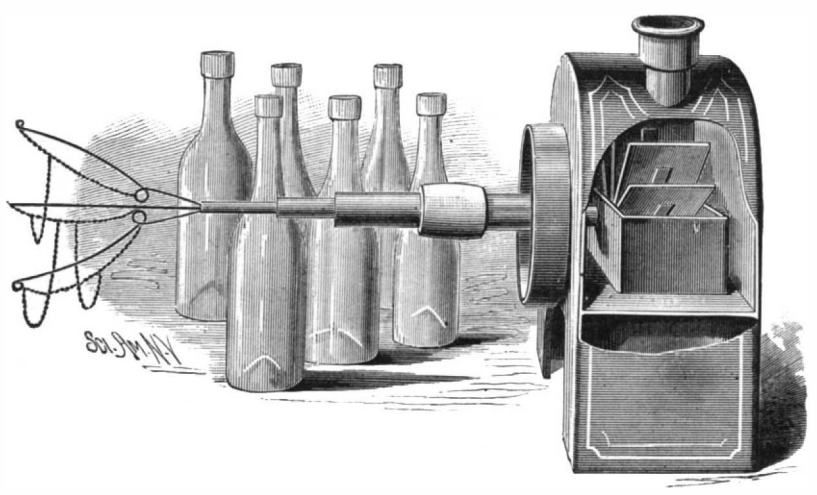
NEW MACHINE FOR WASHING BOTTLES.

The engraving shows a simple machine for washing bottles, lamp chimneys, tumblers, and other similar vessels. It consists of a shaft revolved by a small water wheel propelled by a jet of water from the faucet on the water pipe.

The brush, which is inserted in the bottle or other vessel to be cleaned, may be of any suitable size or form; the illustration shows three wire arms springing outwardly and carrying chains which are thrown against the inner surface of the vessel by centrifugal force.

These chains loosen any adhering matter and agitate the soap and water so that the bottle is rapidly and thoroughly cleansed.

This invention was recently patented by Mr. M. Cody, of Boston, Mass.



MACHINE FOR WASHING BOTTLES.

Bleaching Gutta Percha.

Dissolve the gutta percha in twenty times its weight of boiling benzole, add to the solution plaster of very good quality, and agitate the mixture from time to time. By reposing for two days the plaster is deposited and carries down with it all the impurities of the gutta percha insoluble in benzole. The clear liquid decanted is introduced by small portions at a time into twice its volume of alcohol of 90 per cent, agitating continually. During this operation the gutta percha is precipitated in the state of a pasty mass, perfectly white. The desiccation of the gutta percha thus purified requires several weeks' exposure to the air, but may be accelerated by trituration in a mortar, which liberate moistures which it tends to retain.—*Journal de Pharmacy.*

IMPROVEMENT IN FEEDING AND WATERING LIVE STOCK ON CARS.

The cruel and barbarous treatment to which animals in transit from the West to Eastern markets are frequently subjected is an old and long-standing abuse. It has been clearly stated and denounced for years as shameful, inhuman, and uneconomical, but up to the present time there has been no substantial improvement in the means and methods provided over those of twenty years ago, when the business was begun.

So important has this question become that the American Humane Association has offered a premium of $5,000 for the best device for, and most practicable improvement in, cattle cars.

From the best information at hand the estimated loss on cattle in transit equals 6 per cent, and about 9 per cent on sheep and swine, the greater portion of which loss is chargeable to improper treatment *en route*. The saving of one half of this percentage would amount to an enormous profit to the cattle interest, and would mean as well better and cheaper meat both in this country and in Europe. Of the cattle that live, many, by reason of starvation and cruelties inflicted while in transit, and after, lose nearly a hundred pounds weight from the sweetest and best part of the meat, and come out of the cars full of fever, or with bruises, sores, and ulcers, and these, together with smaller animals, to which the loss and suffering are proportionately great, are all sold in our market for food.

If there were no other side to this question than that which pertains to the "profit and loss account" of the business ledger, we might be content to leave the subject here, letting those whose economical interests are involved discover the remedy. Such, however, is not the case, for it has become well settled through our Boards of Health at the commercial centers, societies of social science, and veterinary experts, that a large portion of the meats offered for sale in our markets is diseased and unfit for consumption, which condition is very largely attributable to the improper and unnatural treatment of live stock during the time of shipment from the West to the East. We can, therefore, only hope for healthy meats for consumption, as a general rule, when live stock are cared for in transit as they should be.

From these facts it appears that cruelty to animals in transportation avenges itself upon the consumer, and that we shall never be secure against disease from eating poisonous meats until animals are properly fed and watered and thus brought in good health to the shambles. This can readily be done without materially adding to the expense of transportation, and with increased profit to all concerned, by adopting the cheap, effectual, and practical method shown in the engraving, which are devices recently perfected by Mr. A. D. Tingley, of this city, and are now owned by the Union Live Stock Feeding Company, of 27 Union Square, and are indorsed by the "Farmers' Club" and Mr. Henry Bergh, of this city. The Feeding Company are negotiating with the trunk railroad lines of this country for the early erection and operation of these feeding stations.

There is, therefore, an urgent need for the introduction of some plan by which the needless suffering of these dumb creatures in transit may be lessened. It has been fully demonstrated by actual tests that, by feeding and watering live stock regularly every twelve hours between St. Louis or Chicago and New York, 50 pounds and upward in shrinkage was saved to each head of cattle, and the condition of the meat materially improved. The following is a moderate estimate of saving to the shipper with eight feeding and watering stations between St. Louis and New York:

Allowing 16 cattle to each car, and a saving in shrinkage of 50 lb. per head, or 800 lb. per car, worth 8 cents per lb., we have a total saving to the shipper on each car load	$64·00
Deduct cost of feeding and watering at 20 cents per head at each station	$25.60
Net saving to the shipper on each car load	$38.40

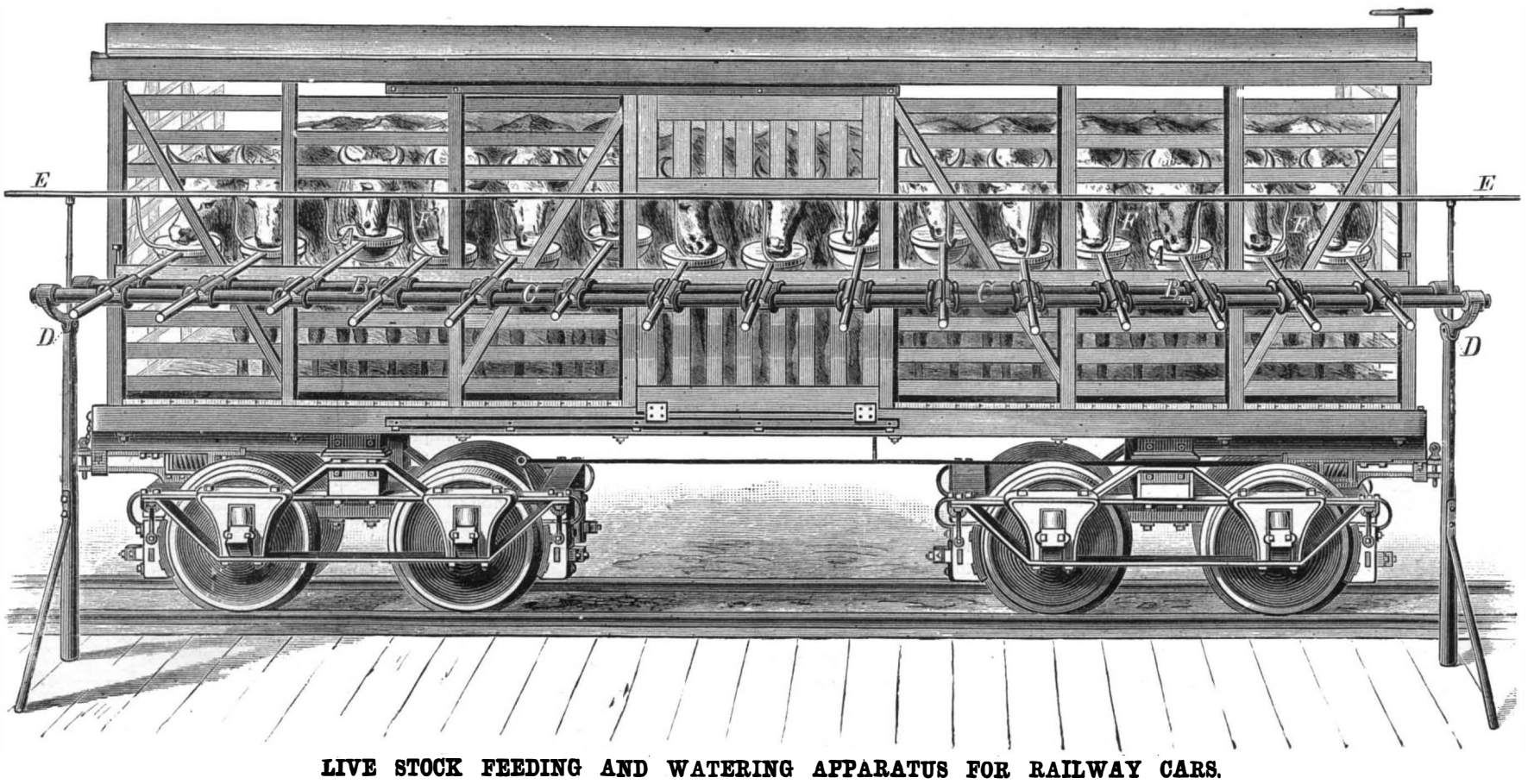
By official reports there were received and shipped at the two cities of St. Louis and Chicago alone, during the year 1879, 14,024,172 head of live stock, and the adoption and use of these devices would save millions of dollars annually to this industry, and at the small charge of five cents per head for the devices which effect this large saving, would bring the Union Live Stock Company an annual net income of over $700,000, besides the great beneficial results to beef consumers. It is a simple device for feeding and watering, entirely separate from the cars, and is erected about twelve hours' run apart, at suitable stopping places along the track on both sides of the car. Its construction and use will appear from the following description, reference being had to letters in the engraving.

A represents a series of feed boxes, with handles which slide back and forth in socket, B, and allow the feed boxes to be pushed in and out of the car as desired. The sockets or supports, B, of the feed boxes (through which the handles slide) slide sideways on the rods, C, giving a lateral movement to the feed boxes to avoid posts and braces when the boxes are pushed into the car. D is a joint or hinge in the upright posts, which gives a slight rocking motion to the horizontal part of the framework, allowing the feed boxes to be slightly raised or lowered. E is the main water pipe, and F represents small leaders from the main water pipe to each separate feed box. It is designed to build a row of these on both sides of the track, and thus get at the heads of the stock, wherever they are. The only alteration required to be made in the stock cars now in use is to loosen one board on each side of the car, head high, and support it on hinges and hooks, so that it may, by lowering, provide an opening for the feed boxes.

This arrangement not only provides in a simple and inexpensive manner for the comfort of the stock, but permits of their transportation with greater dispatch, since it avoids the labor and delay of unloading.

Unfit for Human Food.

At the regular session of the Health Board yesterday, Dr. Ewing, executive officer of the Night Medical Service, reported that during the month of October thirty-eight persons had been treated by twenty-five physicians. Assistant Sanitary Superintendent Dr. Janes informs the Commissioners that on the 11th inst. he visited two slaughter houses on First avenue and seized several quarters of beef which was unfit to eat. In closing his communication Dr. Janes stated that he understood that the cattle were weak and sickly before being killed, and that the butchers were in the habit of selling the meat to Bologna sausage makers for two or three cents a pound. A committee of the leading cattle slaughterers in this city asked the Board to appoint a veterinary surgeon as an inspector of cattle and slaughter houses. —*New York Daily Herald, Nov.* 17.



LIVE STOCK FEEDING AND WATERING APPARATUS FOR RAILWAY CARS.

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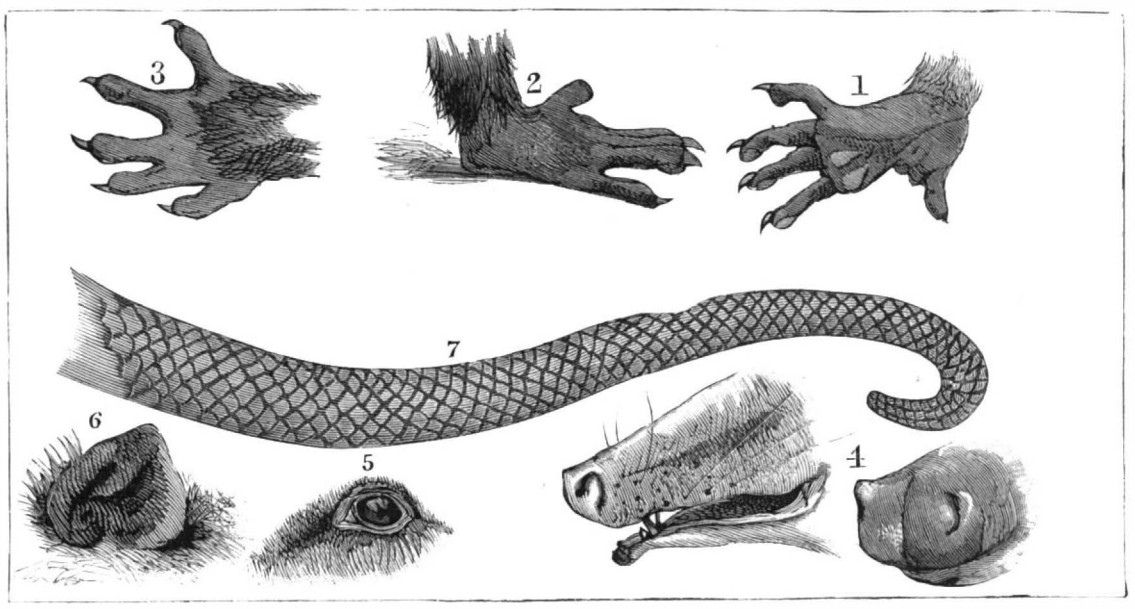
BORN BLIND AND DEAF.

BY DANIEL C. BEARD.

Australia seems to be a spot set aside by nature for experiments in curious forms of animal life. By some means, in the far distant past, a representative of that singular order, the marsupials, reached North America, where it is still to be found in abundance, a source of wonder to the ignorant and a puzzle to men of science. It was not until 1848 that the mysteries and fables shrouding the birth of this animal were swept away by Bachman and some of his friends, who, by diligent work and patient experiment, set aside forever the wild theories of such men as Valentine, Marcgrave, Piso, Beverly, Pennant, and others, who held that the young of this creature grow upon the mammæ as the fruit does upon a stalk!

The *Didelphis virginianus*, in other words, the common opossum, is described by scientists as follows: "Head long and conical, muzzle pointed, ears large and membranous, rounded, and almost naked, tongue aculeated, internal toe of hind foot opposable to fingers," etc. Equally good and far less technical is the description given by a small street Arab as he gazed at one of these animals in the writer's possession: "Oh, looky, Billy," said he, "see that big rat; hit's got a pig's head, a coon's body, monkey's feet, and a rat's tail." The accuracy of the last description may be tested by reference to the accompanying engraving showing the parts in detail.



OPOSSUM.—1 Bottom of hind foot.—2. Top of hind foot.—3. Top of fore foot.—4. Side and front of snout.—5. Eye.—6. Ear.—7. Prehensile tail.

According to "Wood," fifteen days elapse, and the young opossum comes into this world, a diminutive, helpless babe, weighing not more than three or four grains, blind, naked, and deaf. It cannot even open its mouth, its jaws being sealed together, a small orifice only left at the muzzle, through which it receives its nourishment. One would think it was ill adapted to buffet with the rough world, but Nature, ever kind to her creatures, has ready prepared a soft cradle for its reception, where it is placed by its mother. The opossum, like its cousin the kangaroo, is a pouched animal; within the pouch are the mammæ; to one of these the young opossum fastens itself almost immediately after being placed in the pouch. The growth of this babe is surprisingly rapid, increasing from three and three-quarter grains to thirty grains in a week. In four weeks' time its funny head may be seen cautiously peering out at the great wide world; and at the end of the fifth week the little fellow is able to leave its snug quarters and venture out. Not being over-confident of its ability to take care of itself it grasps with its prehensile tail the tail of its mother.

Next to the rabbit the Virginia opossum is one of the most prolific of animals, often appearing with a dozen or more in its pouch, while other older ones cluster upon its back, firmly anchored there by their tails.

You have but to spend a short time upon some Southern plantation to learn the charms of a 'possum hunt, and if you can overcome your scruples enough to taste the meat after it is prepared by one of the sable huntsmen, you will pronounce it good.

Though this marsupial sometimes makes raids upon hens' nests, and occasionally upon the hens themselves, the good it accomplishes in exterminating other more mischievous animals doubly repays for a few stolen eggs and an occasional chicken. One that Bachman kept in a stable chased or devoured every rat upon the place.

Through the kindness of my friend Mr. John Walker, of Flushing, I secured a large female opossum from Charleston, S. C. When caught she had three young ones in her pouch, but when the Charleston steamer arrived at this port I was disappointed to find the young ones missing. It is said that these animals are readily domesticated, soon becoming very tame and gentle, which is probably true. But the one I have, possibly through disappointment at the loss of her family, has a very ugly temper. She occupies the house formerly the home of the pygmy musk deer, an illustration and description of which was published in this paper in April, 1879. Whenever I approach the house she retreats to the furthermost corner, and there, with distended jaws, defies further molestation.

Removal of Grease Spots.

Fatty oils have a greater surface tension than oil of turpentine, benzole, or ether. Hence, if a grease spot on a piece of cloth be moistened on the reverse side with one of these solvents, the tension on the greasy side is larger, and therefore the mixture of benzole and fat or grease will tend to move towards the main grease spot. If we were to moisten the center of this spot with benzole, we should not remove it, but drive the grease upon the clean portion of the cloth. It is, therefore, necessary to distribute the benzole first over a circle surrounding the grease spot, to approach the latter gradually, at the same time having blotting paper in contact with the spot to absorb the fat immediately.

Another method, namely, to apply a hot iron on one side, while blotting paper is applied to the other, depends upon the fact that the surface tension of a substance diminishes with a rise of temperature. If, therefore, the temperature at different portions or sides of the cloth is different, the fat acquires a tendency to move from the hotter parts towards the cooler.—*The Pharmacist.*

Chicago's Manufacturing Industries.

The recent census of the manufacturing industries of Chicago discloses evidence of a phenomenal rate of progress during the last ten years. The footings show 3,752 establishments, $80,692,102 capital, 113,507 persons employed, $37,615,381 wages paid, and $253,405,695 in value of the articles manufactured. This is nearly three times the annual product in 1870. The leading industry is meat

OPOSSUM.—*Didelphis Virginianus.*

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packing: 72 establishments, with $8,464,000 capital, employ 12,891 persons, and put up $81,570,000 in value of meats. The iron and steel manufactures reach about $25,000,000. The rolling mill products are valued at $15,673,624, not including the Bessemer Steel Works, the values for which are merged in a general item. The manufacture of clothing foots up $17,423,607; sash, doors, etc., $8,981,281; bridges and railroad stock, $8,030,398; furniture, $7,188,278; tanning and currying, $5,637,000; alcohol and rectifying, $5,024,220; lard oil, $6,508,800.

DECISIONS RELATING TO PATENTS.

United States Circuit Court—District of Vermont.

HOLLY *vs.* VERGENNES MACHINE COMPANY.

Wheeler, J.:

1. The meaning of the claims in a patent is to be derived from the specification.

2. Two devices are substantially the same in the sense of the law of patents when they perform the same functions in substantially the same way to accomplish the same result, and, except when form is of the essence of the invention, it should not be regarded in the question of infringement.

3. In determining the matter of infringement attention should be paid to such portions as really do the work, so as not to give undue importance to parts used only as a convenient mode of construction.

4. The patentee is entitled to the exclusive use of the whole of his patented invention, and if it is of a combination of numerous parts, including in it other new and useful combinations of less of the parts, he seems to be entitled to the exclusive use of these lesser combinations, as well as to the exclusive use of the whole.

This suit is brought upon reissued letters patent, No. 5,132, dated November 5, 1872, for a new system of waterworks for supplying cities and towns with water, and original letters patent, No. 94,747, dated September 14, 1869, for a new safety valve for street water pipes, both granted to the plaintiff. The defenses are that the plaintiff is not the original and first inventor of the inventions described in the patents, and that the defendants do not infringe. The cause was heard at last term on pleadings, proofs, and arguments of counsel.

Before the plaintiff's invention water to supply cities and towns was, when the supply was located high enough, drawn into a reservoir, and from thence into a main pipe, from which others ramified through all parts of the city or town and into dwellings and other places to spigots, from which it could be drawn as wanted for use. In level places, where there was still an elevation for a reservoir, it was forced by pumps into a reservoir, and when there was no such elevation it was forced into a stand-pipe of the necessary size and height or into mains connecting with such a stand pipe, and the pressure of the water in the reservoirs or stand-pipes would regulate the flow to the spigots and hydrants. Where it had to be supplied by pumps the irregularity in the amount drawn at the spigots and hydrants would not admit of a uniform supply to the mains, and if pumps were employed for furnishing such a supply the incompressibility of water is such that when the drawing ceased the pipes would burst or the pumps or machinery be broken.

The plaintiff's inventions obviated these difficulties by providing pumping machinery which increasing pressure of water in the mains would slacken and decreasing pressure would hasten, and guarding against sudden shocks from the quick closing of hydrants by the use of an air chamber connecting with the mains, and preventing the danger of continued pressure from that source while the machinery was slackening by a peculiarly arranged relief valve applied to the mains, so that the water could be pumped directly into the mains and drawn therefrom by the spigots and hydrants at pleasure with safety to the works without any stand-pipe or reservoir. None of the systems set up as anticipations had these contrivances combined in this manner.

The London waterworks, constructed by Peter Maurice in 1582, as described by Thomas Ewbank in "Hydraulics and Mechanics;" the system of waterworks described in the English patent to Joseph Bramah, dated October 31, 1812; and the London bridge waterworks, described by William Mathews in "Hydraulia, 1835," had pumps forcing water directly into mains to be carried to inhabitants; but neither of them had any contrivances for slackening the quantity forced as any pressure increased from diminishing the quantity drawn, as described; neither does it appear from the descriptions given but that the water flowed through by a constant flow, and was caught as wanted for use. Birkinbine's system at the State Lunatic Hospital at Harrisburg, Pennsylvania, had connection with a reservoir at the top of the building. Linsley's system at Burlington, Vermont, had connection with a reservoir above the city. Birkinbine had no means for regulating the quantity pumped by the severity of the pressure in the mains, and Linsley had none for lessening the quantity as the pressure increased. His system was nearer like the plaintiff's than any other was, but his lacked some of the essential features of the plaintiff's. His had means for slackening the pumping machinery when the pressure in the mains decreased, to prevent the machinery from running away if the pressure should be removed by bursting or other casualty; but this is quite different from regulating the supply according to the pressure. He had pipes leading each way from the main carrying the water up to the reservoir, and as to those pipes the water was pumped directly into them without going to the reservoir; but as they were connected by the main with the reservoir the pressure in them would be regulated by the pressure from the reservoir, and would not in any manner regulate the quantity pumped according to their requirements. Birkinbine had a safety valve on the main for the same purposes as the plaintiff's relief valve; but his valve was held by dead weights, while the plaintiff's is steadied by a dash pot. None of these things show that the plaintiff was not the original and first inventor of the inventions described in both patents.

This is in accordance with the decision of Drummond and Gresham, J. J., in *Holly vs. Union City* (14 O. G., 5), so far as that decision goes, which only involves the reissued patent. This suit rests upon the first claim to that patent, which is for—

"The above-described method of supplying a city with water—that is to say, by pumping directly into the water mains when the apparatus for that purpose is supplied with contrivances by which the pressure within those mains may be preserved in a great degree uniform, sufficiently so for practical purposes, or increased or diminished at pleasure, substantially as and for the purpose above shown."

It is objected that this claim does not specify any devices constituting the system mentioned, and that it is too indefinite to furnish a foundation for a claim for infringement; but this objection cannot prevail. The patent is to be read altogether for the purpose of ascertaining the meaning of the whole and of every part. Consequently the specification may be referred to for ascertaining the meaning of the claims. (*Bates vs. Coe*, 15 O. G., 337; *Brooks vs. Fish*, 15 Haw., 215.)

The specification describes pumping apparatus which the increase of pressure in the mains will slacken and decrease will hasten. It describes mains connected with an air chamber and a relief valve for easing the shock of sudden and continued pressure, and mains from which the water is drawn as wanted, or closed mains, operating by pumping the water directly into the mains without a reservoir or stand-pipe. The claim of the system as and for the purposes above shown is a claim for this combination of these various contrivances, operating together in this manner for this purpose. It is for these devices so combined and arranged, and not for any abstract principle or method apart from the devices themselves. The claim appears to be valid when so construed. (*Holly vs. Union City*, 14 O. G., 5.)

The plaintiff's pumping apparatus is arranged so that the increase of pressure in the mains will lessen the amount of water being pumped into them by forcing the water against a piston, the motion of which, operating through complicated devices, shuts off the motive power and slackens the pumps. This is the pumping apparatus supplied with contrivances by which the pressure within the mains may be preserved in a great degree uniform which is mentioned in this first claim, and that part of the patented invention covered by this claim is the combination of this apparatus with the mains, the air chamber, the relief valve, the pipes, and the spigots.

The answer and the evidence show that the defendants have put in waterworks for cities and towns, or participated in putting them in, which have the pumping apparatus described in letters patent No. 154,468, dated August 25, 1864, issued to John P. Flanders, one of the defendants, for an improvement in pumps, stated in the specification to relate more particularly to pumping engines adapted to the delivery of large volumes of water, as in town or city supply where no stand-pipe or reservoir is employed, and in the description referring only to such engines as pump directly into the mains. In this pumping apparatus the increasing pressure of the water in the mains decreases the amount of water pumped in by acting upon a valve, which opens and closes a duct leading from one end of the pump cylinder to the other around past the piston, so that when the pressure opens the valve the water is pumped from one side of the piston to the other and not forced along, and when the pressure is diminished by the opening of the spigots and drawing water the valve closes and the water is forced along again to take the place of that drawn off. This is a pumping apparatus supplied with contrivances by which the pressure within the mains may be preserved in a great degree uniform, as mentioned in this claim of this original patent of the plaintiff. The combination and arrangement are the same in defendants' works as in the plaintiff's, unless there is a substantial difference in these pumping engines, and the rest of the combination is the same, whether there is a difference here or not.

Two questions arise here: One is whether these pumping engines are substantially the same in this arrangement, and the other is whether the rest of the arrangement is a part of the plaintiff's patented invention if they are not. If they are, the defendants have taken the whole of the invention covered by this claim. If they are not, and the rest of the combination without them is covered by the patent, then the defendants have taken so much of the patented invention. In this matter of regulating the flow of water in such pipes according to the wants of consumers, without the aid of the force of gravitation furnished by reservoirs and stand-pipes, the plaintiff precedes Flanders and has produced something which underlies all that Flanders has produced, and if it includes what Flanders has produced, he has a monopoly of it. (*Railway Co. vs. Sayles*, 97 U. S., 554.) And these pumping machines are substantially the same in the sense of the law of patents when they perform the same function in substantially the same way to accomplish the same result, and except where form is of the essence of the invention it should not be regarded in questions of this kind, and it is not of the essence of this invention. Attention should be paid to such portions as really do the work, so as not to give undue importance to parts used only as a convenient mode of construction. (*Machine Co. vs. Murphy*, 97 U. S., 120.)

Here the pressure in the mains does the work of lessening the flow. In the plaintiff's machine it does it by pressing against a valve and slackening the machinery propelling the water. In the defendants' machine it does it by pressing against a valve and lessening the effect of the machinery upon the water. The means are the same, the result the same, and the mode is different only in form. (*Foster vs. Moore*, 1 Curtis' C. C., 279.) If this was not so, the arrangement of the mains, air chamber, relief valve, and pipes was new, and a material part of the invention, which would be covered and included in this claim of the patent, and which the defendants would have no right to take and use in connection with Flanders' invention. (*Sellers vs. Dickinson*, 6 E. L. and Eq., 544, 5 Exch., 312; *Lister vs. Leather*, 8 Ell. and Backb., 1,004.)

Flanders' pumping apparatus is the equivalent of the plaintiff's in making up a system of waterworks with these other parts, although it may not be the same thing for other purposes. The question now is not whether they are the equivalents of each other for all purposes, but is whether they are for this purpose.

In *Sellers vs. Dickinson* the patent was for machinery, consisting, among other things, of a clutch box operating automatically to cut off the power from a loom whenever the shuttle became entangled, combined with other mechanical contrivances through which the momentum of the sley was made to move a brake against the flywheel to take up the momentum of the parts and prevent sudden shock from the stoppage. The clutch box was old, but its combination with the brake was new. The defendant's contrivance for accomplishing the same object, and for which he had obtained a patent, dispensed with a clutch box and had different contrivances from the plaintiff's for applying the momentum of the sley to the brake. It was argued that the patent was for a combination, and that there could be no infringement unless the whole combination of the same elements was used. This argument was overruled, Pollock, C. B., saying that if a portion of a patent for a new arrangement of machinery is in itself new and useful, and another person, for the purpose of producing the same effect, uses that portion of the arrangement and substitutes for the other matters combined with it another mechanical equivalent, that would be an infringement, and the plaintiff there had judgment. The defendants here use the pressure in the mains for the same purpose that the plaintiff does, and thereby complete the arrangement of the plaintiff's patent, the same as the defendant there used the momentum of the sley for the same purpose that the plaintiff there did, thereby completing the combination of that patent. These views do not differ from the decision in *Prouty vs. Ruggles* (16 Pet., 336) and like cases, where it is held that a patent for a combination of several parts to accomplish a part is not infringed by a combination of less of the same parts alone, or with other substantially different, to produce the same result. That case was put expressly upon the ground that neither any of the parts nor any portion of the combination less than the whole was new.

The patentee is entitled to the exclusive use of the whole of his patented invention, and if it is of a combination of numerous parts, including in it other new and useful combinations of less of the parts, he seems to be entitled to the exclusive use of these lesser combinations, as well as to the exclusive use of the whole. (*Sharp vs. Tifft*, 17 O. G., 1,282.)

The pumping apparatus of Flanders may be an improvement upon that of the plaintiff, and properly patentable as such, so as to entitle him to the exclusive use of those particular devices, but that would give him no right to use his devices to infringe the plaintiff's patent with, although this fact may be of importance in determining the amount of profits or damages due to such infringement.

The other patent is for a dash-pot combined with a safety valve upon water pipes subjected to great pressure, to steady the motions of the valve in opening and closing. The dash-pot is an old and well known contrivance for steadying motion, but it had never been combined with such valves before. The defendants use a dash-pot in the same combination, but they claim they do not infringe because their dash-pot is different from the plaintiff's. The plaintiff's is closed at the top and receives water, in which the loose piston works, at the bottom from the main on which it is placed. The defendants' is open at the top and receives water there, and is closed at the bottom. Their operation in steadying motion is alike. The pressure of the water in the main may communicate some motion to the piston in the plaintiff's dash-pot which it cannot do to that of the defendants'; but that is not noticed in the patent. The dash-pots each accomplish the same result by the same means in substantially the same way. The combination is the same, and the use of theirs by the defendants infringes the patent of the plaintiff's. (*Machine Company vs. Murphy*, 97 U. S., 120.)

It has been urged in argument that the defendants only make and sell the Flanders pump, and that they do not infringe the plaintiff's patents, although their purchasers may have infringed by putting them into systems of waterworks. If all they did was to make and sell these pumps merely, probably they would not infringe by that alone; but the answer and proofs go beyond this. Flanders, in his testimony as to what works they have put up, does not limit what they did to making and selling the pumps merely. The effect of the whole clearly is, they participated and concurred

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in putting in the whole by furnishing the pumps for that purpose, and this is sufficient to make them liable as infringers. (*Bowker vs. Dows*, 15 O. G., 510.)

Let a decree be entered that the first claim of the reissued patent and the other patent are valid; that the defendants have infringed both, and for an injunction and an account, with costs.

U. S. Circuit Court—Northern District of Illinois.

THE NATIONAL CAR BRAKE SHOE COMPANY *vs.* THE LAKE SHORE AND MICHIGAN SOUTHERN RAILWAY COMPANY. SAME *vs.* THE ILLINOIS CENTRAL RAILROAD COMPANY. —PATENT SHOE FOR CAR BRAKES. PATENT OF OCTOBER 6, 1863.

Drummond, J.:

1. Effect must be given to the whole of the description contained in the specification and drawings of a patent. Hence, if it can be ascertained that a patentee intended to divide his invention into two parts, and to describe and claim them as separate improvements, the patent must be construed according to his intention, so as to give full effect to each part of the invention.

2. Where a patent claims, first, a combination of two parts so arranged that one can have a "lateral rocking motion" on the other, and, secondly, a combination of the same parts with two additional elements, "the whole being constructed and arranged substantially as specified," but not in terms referring to the rocking motion, the second claim is infringed by the use of its combination of mechanism, although the arrangement is such as not to permit any rocking motion.

Patent sustained.

The Cracking of Paint.

What is the cause of paint cracking? You may ask a dozen painters that question, and each will have a different answer. One will say, it has got too much oil in it; another, there is too much japan in it; again not enough oil in it; others, that your paint dries too quick; and so we might go on and fill pages with the answers that you would receive from different painters, for each will have a different answer. The general conclusion of observant painters is that the cracking of paint is caused more by the use of oil and hurried work than anything else.

A great many painters persist in mixing their paints to have them very elastic all the way through, thinking they will have a tough elastic surface that will give like rubber to the swelling and shrinking of the wood, without cracking, and would scarcely break apart if the panel were split in two. Well, we will admit they could get a very elastic coat, and providing it remained that way and never dry hard, it would be just the thing; but the paint is bound to dry hard some time, and any material will contract in drying. The elastic body of paint will continue to dry and contract, until its elasticity gets to its utmost limits, when it will give way and spread open in big cracks, looking the same as house painter's paint when it cracks.

To paint a job up with elastic coats of paint, it should go through a very long process, longer than anybody would want to give, the way painting is hurried now. The different coats should be put on very thin, and each allowed to dry thoroughly before another is put on. Putting on a number of heavy coats of any kind of paint or rough stuff as fast as you can, or before the under coat is dried through, will cause cracking of the worst kind, either before or after varnishing.

Paint too often is supposed to be dry, when really it is not half dry. It formerly took six months or more to get a job ready for finishing on the elastic principle, and then you would want good drying weather; but now you must paint a job through and through in a month, or even a shorter time, and the job supposed to last the same.

The quick process or flat coating can also be hurried so that it will crack, and crack badly too. Our ideas of obviating the cracking of paint are these: let every part of the wood be thoroughly primed with good fresh priming; prime inside and out, or use slush on the inside, which is just as good as priming, so that the water cannot act on the wood. Let the priming get perfectly dry, then mix every coat of lead, so that it will dry hard. Mix the filling with japan and varnish, so that this may dry firm and hard; use no oil in it. Have every coat dead color; do not have them with a gloss color, which is very deceiving, appearing dry, but when the subsequent coats are put on, they go into what is known as color cracks, caused by the under coats not being hard.

Do not apply the coats too heavy; have them as thin as possible to answer your purpose, and let each get thoroughly dry before putting on another. Place enough coats on to fill the grain of the wood, making a perfect surface. Then you will have on a body of paint firmly bound together, and thoroughly dry. When paint is thoroughly dry, it can shrink no more, as it only shrinks when in the process of drying, and if it does not shrink, it cannot crack; also in this kind of a body of paint, there is no moisture or oil to sweat out and destroy the luster of the varnish.

Painting of this description will not crack until the joints of the wood begin to give way, admitting water and damp atmosphere, which swells the wood along the edges of the joints, causing the paint to crack from the swelling and shrinking of the wood. Varnish may crack on top of the best painting ever done, and the underneath or foundation be solid. We have seen where the varnish on jobs was cracked terribly, but in taking the varnish off by the use of spirits of ammonia, found the filling as sound as it was possible to be.

If the paint is not well protected by varnish, it will perish in time, sooner or later, owing to how well it is protected. A job to be kept in good order should not be allowed to go for two or three years without having anything done to it; we have seen men who would complain because the painting did not last as long as the carriage, thinking, we supposed, that the one painting was enough. Once a year is enough to have a carriage varnished to be kept in order, though no rule is laid down, except when it commences to look as if it wanted varnishing, have it done; don't wait until it wants burning off before attending to it.

Nowadays, painters will paint jobs in two weeks, and wonder at the cracks. The blame is generally laid on the material, or on anything else handy and suitable, but the real cause is, finishing the job in two weeks, requiring the coats to dry as hard as possible, and trust to luck for results. —*Carriage Monthly.*

Astronomical Notes.

OBSERVATORY OF VASSAR COLLEGE.

The computations in the following notes are by students of Vassar College. Although merely approximate, they are sufficiently accurate to enable the observer to recognize the planets. M. M.

POSITIONS OF PLANETS FOR DECEMBER, 1880.

Mercury.

Mercury can be seen only in the morning. On December 1 Mercury rises at 5h. 47m. A.M. On December 31 Mercury rises at 6h. 34m. A.M.

Mercury is at its greatest elongation west of the sun on the 12th.

Mercury passes Mars on December 23.

Venus.

Venus will be brilliant in the southwest all through December, setting later and later. On December 31 it sets about 8 P.M.

The moon passes north and east of Venus December 4.

Mars.

On December 1 Mars rises at 6h. 16m. A.M. On December 31 Mars rises at 6h. 15m. A.M.

Mars and Mercury are in conjunction on December 23. According to the "Nautical Almanac" Mercury is 1° north of Mars at 8 A.M.

Jupiter.

Although Jupiter is long past its perihelion, it is still the great light of the evening skies, coming to the meridian early in the evening, and at a good altitude for amateur observers in this latitude. Its altitude is about 51° to 52° through the month of December.

On December 1 Jupiter rises at 1h. 44m. A.M. On the 31st at 11h. 48m. A.M.

Saturn.

Saturn can be known by its position in regard to Jupiter. It follows Jupiter at a distance of 12½° on December 1, and 10° on the 31st.

Saturn is nearly 4° north of Jupiter in declination on December 1, and 3° north of Jupiter on the 31st.

Saturn rises at 2h. 20m. P.M. December 1; at 0h. 20m. P.M. December 31.

Saturn is stationary among the stars December 24.

Uranus.

Uranus rises at 11h. 49m. P.M. December 1; at 9h. 51m. P.M. December 31.

Uranus comes to the meridian at 6h. 14m. A.M. on December 1; at 4h. 16m. on the 31st, for this meridian.

PHENOMENA OF JUPITER'S SATELLITES.

December 1.—A little before 9 satellite I. enters on a transit.

December 2.—About 9:15 satellite I. reappears from eclipse.

December 3.—About 8:15 satellite II. completes a transit.

December 5.—Just before 8:15 satellite III. reappears from occultation.

December 8.—At 10 satellite I. is very near Jupiter, being about to make a transit.

December 9.—Between 8 and 2 satellite I. is missing in occultation.

December 10.—About 8:15 satellite II. enters on a transit.

December 12.—At 8 satellite II. is very near the planet, having just reappeared from eclipse.

About 9:15 satellite III. is occulted.

December 16.—About 9:45 satellite I. is occulted.

December 17.—A little after 9 satellite I. reappears after transit.

December 18.—At 8 satellite I. is very near Jupiter, having just appeared after eclipse.

December 19.—Satellite II. is missing in eclipse between 8 and 10.

December 24.—About 8:45 satellite I. enters on a transit.

December 25.—A little after 8:30 satellite I. reappears from eclipse.

December 26.—Between 8 and 10 satellite II. is missing in occultation.

December 30.—A little before 10 satellite III. reappears after transit.

A. K. FITZHUGH.

Decomposition of the Elements.

It has been known for some time, says the *Photographic News*, that simple relations exist between the spectra of the elements in a natural group, consisting in the homologous relations of the lines of the spectra. Similar relations are also found in the spectra of compounds. For example, cyanogen gives a peculiar spectrum, the more refrangible half of which is comparable to the carbon spectrum, and the less refrangible half to the nitrogen spectrum of the first order, and they are respectively homologous with these spectra; similar relations are observed with carbon monoxide.

As now the spectrum of cyanogen is homologous in one half with the spectrum of carbon, and in the other half with the spectrum of nitrogen, because it contains both these substances, in like manner similar cases might be inferred in the homologous relations of the spectra of certain elements.

Dr. Ciamician, of Vienna, carried this out exhaustively in the Academy of Sciences. He thinks the cause of the homologous relations of the spectra of the elements could be explained by the assumption that the elements are compound, and gives the following surprising explanations.

1. The spectra of the elements carbon, boron, beryllium, and magnesium are perfectly homologous with one another. These four elements consist, therefore, of the same material, which exists in different grades of condensation, which finds expression in the displacement of the homologous lines. The atomic weights of carbon (12) and boron are, in fact, near one another; the atomic weight of magnesium is double that of carbon (24). Cimician calls these groups "Carbonoide."

2. The spectra of silicium and aluminum are homologous with one another, and the more refrangible side corresponds with the spectrum of carbon, the less refrangible with that of oxygen. Silicium consists, therefore, of carbon and oxygen, corrresponding to 12+16=28 (atomic weight of silicium).

Aluminum contains the carbon in the form of boron and oxygen, as its atomic weight (11+16=27) indicates.

3. The elements of the alkaline earth metals have spectra, the more refrangible part of which corresponds with the spectrum of magnesium, and the less refrangible part with the spectra of the elements of the oxygen series. Therefore calcium, strontium, and barium consist of carbon in the form of magnesium, and oxygen in the condensation forms of sulphur, selenium, and tellurium, corresponding to the atomic weights: Ca=24+16, Si=24+4·16, Ba=24+7·16.

4. The elements of the oxygen group all consist of the same material, which is found in different stages of condensation; which finds expression in the displacement of the homologous lines, and in certain other peculiarities in the formation of the homologous groups of lines in the spectrum. The atomic weights of the elements of the series are: O=16, S=16+1·16, Se=16+4·16, Te=16+7·16.

5. The halogens all consist of fluorine and oxygen in different forms of condensation; the atomic weights of the elements of this group—Cl=19+16, Br=19+4·16, I=19+7·16—express these relations. In this series, as is known, the composition of single members has been conjectured for a considerable time, and they have been thought likewise to consist of fluorine and oxygen.

6. The spectra of the nitrogen group are homologous in the less refrangible part with the nitrogen spectrum, in the more refrangible part with the spectra of the elements of the oxygen group. The elements of the nitrogen group consist accordingly of nitrogen and oxygen in different grades of condensation, which agrees with the atomic weights: N=14, P=14+16, As=14+4·16, Sb=14+7·16.

If one relies on this hypothesis, then the remarkable relations of the atomic weights of the elements to one another appear perfectly intelligible. We have then, in the so-called elements of inorganic chemistry, really to do with homologous series, which can quite be compared with the homologous series of organic compounds, which has besides been already conjectured by different authors.

We see, further, that with increasing condensation of the material the metallic character is always more clearly marked; the higher members of a series have always more metallic properties.

It is probable that the present fundamental substance can be collectively referred to the typical elements—hydrogen, carbon, nitrogen, oxygen, and fluorine; it is not, however, implied that these are to be considered as the final components of the material.

The Load of a Freight Car.

A rapid increase has been going on during recent years in the amount of freight regarded as the maximum load of a car. Formerly 20,000 pounds was the limit; now, according to the Western Weighing Association, the average of the different classes of freight, as determined by the weights of 50,000 cars weighed during a period of six weeks, was from 23,750 for machinery to 29,925 for ore, the maximum in nearly all cases exceeding 30,000 pounds. Certain classes of freight reached, respectively, as high as 35,000, 37,750, 39,300, 39,600, and even, in the case of ore, to the enormous weight of 48,500 pounds, or more than 24 tons. The superintendent of the association is satisfied that the various articles of freight enumerated, 23 in number, will average fully 27,000 pounds per car, and the whole will not average less than 25,000 pounds per car. The fact that such loads can be safely carried now is due to the vastly improved condition of tracks as well as to the heavier construction of the car.

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Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

☞ *The publishers of this paper guarantee to advertisers a circulation of not less than 50,000 copies every weekly issue.*

Chard's Extra Heavy Machinery Oil.

Chard's Anti-Corrosive Cylinder Oil.

Chard's Patent Lubricene and Gear Grease.

R. J. Chard, Sole Proprietor, 6 Burling Slip, New York.

Bracket Woods.—Wm. E. Uptegrove, Saw Mills, 463 East 10th St., New York, offers to the trade a choice stock of these woods. Send for price list.

OFFICE CITY WATER WORKS, CIN., O., April 16, 1880.
I take pleasure in stating that of all the coverings now in use at City Water Works, embracing 15,000 square feet of various kinds, the H. W. Johns Asbestos Air Chamber Covering is by far the best, not only in efficiency, but also in durability and lightness.
(Signed) THOM. H. RYON, Assist.-Engineer in charge.
H. W. Johns M'f'g Co., 87 Maiden Lane, New York, sole manufacturers.

Astronomical Telescopes, first quality & low prices, Eye Pieces, Micrometers, etc. W. T. Gregg, 75 Fulton St., N.Y.

Money to Invest in Manufacture; Box 1084, Batavia, N.Y.

Wanted—A man competent to take charge of the Metal Working Department of a large Manufactory. He must be energetic, quick, and inventive, as well as practically familiar with the best methods of press and die work, particularly in brass. Answer, stating qualifications in detail, as well as name and references, which will be received in confidence. R. S. & Co., Box 773, N. Y.

Wanted.—A few good Wood Turners wanted to work on Gauge and Waymoth Lathes. One competent to superintend shop. Good wages and steady employment. Winter & Ball, cor. Grove and 13th Sts., Jersey City, N. J.

Wanted—Metal Pattern Makers accustomed to small work. Ad. St. Louis Malleable Iron Co., St. Louis, Mo.

Engines. Geo. F. Shedd, Waltham, Mass.

The Mackinnon Pen or Fluid Pencil. The commercial pen of the age. The only successful reservoir pen in the market. The only pen in the world with a diamond circle around the point. The only reservoir pen supplied with a gravitating valve; others substitute a spring, which soon gets out of order. The only pen accompanied by a written guarantee from the manufacturers. The only pen that will stand the test of time. A history of the Mackinnon Pen; its uses, prices, etc., free. Mackinnon Pen Co. 200 Broadway, New York.

Wiley & Russell M'f'g Co. See adv., p. 333.

Among the numerous Mowing Machines now in use, none ranks so high as the Eureka. It does perfect work and gives universal satisfaction. Farmers in want of a mowing machine will consult their best interests by sending for illustrated circular, to Eureka Mower Company, Towanda, Pa.

Brass & Copper in sheets, wire & blanks. See ad. p. 364.

Wanted—A Man as Superintendent and Foreman of Machine and Foundry (N. Y. State). Manufacturing a specialty. Good business and mechanical ability required. Giving antecedents, references, and salary desired. Address Iron, P. O. Box 255, New York city.

Diamond Planers. J. Dickinson, 64 Nassau St., N. Y.

The Inventors Institute, Cooper Union Building, New York. Sales of patent rights negotiated and inventions exhibited for subscribers. Send for circular.

Fragrant Vanity Fair Tobacco and Cigarettes. 7 First Prize Medals—Vienna, 1873; Philadelphia, 1876; Paris, 1878; Sydney, 1879—awarded Wm. S. Kimball & Co., Rochester, N. Y.

Superior Malleable Castings at moderate rates of Richard P. Pim, Wilmington, Del.

Wood-Working Machinery of Improved Design and Workmanship. Cordesman, Egan & Co., Cincinnati, O.

The E. Stebbins Manuf'g Co. (Brightwood, P. O.), Springfield, Mass., are prepared to furnish all kinds of Brass and Composition Castings at short notice; also Babbitt Metal. The quality of the work is what has given this foundry its high reputation. All work guaranteed.

The "1880" Lace Cutter by mail for 50 cts.; discount to the trade. Sterling Elliott, 262 Dover St., Boston, Mass.

The Tools, Fixtures, and Patterns of the Taunton Foundry and Machine Company for sale, by the George Place Machinery Agency, 121 Chambers St., New York.

Improved Rock Drills and Air Compressors. Illustrated catalogues and information gladly furnished. Address Ingersoll Rock Drill Co., 1½ Park Place, N. Y.

Eagle Anvils, 10 cents per pound. Fully warranted.

Mineral Lands Prospected, Artesian Wells Bored, by Pa. Diamond Drill Co. Box 423, Pottsville, Pa. See p. 349.

Packing once tried always used. Phœnix Packing from 1-16 up in spools or on coils. Phœnix Packing Company, 108 Liberty St., N. Y.

Experts in Patent Causes and Mechanical Counsel. Park Benjamin & Bro., 50 Astor House, New York.

Corrugated Wrought Iron for Tires on Traction Engines, etc. Sole mfrs., H. Lloyd, Son & Co., Pittsb'g, Pa.

Malleable and Gray Iron Castings, all descriptions, by Erie Malleable Iron Company, limited, Erie, Pa.

Skinner & Wood, Erie, Pa., Portable and Stationary Engines, are full of orders, and withdraw their illustrated advertisement. Send for their new circulars.

Power, Foot, and Hand Presses for Metal Workers. Lowest prices. Peerless Punch & Shear Co., 52 Dey St., N.Y.

Recipes and Information on all Industrial Processes. Park Benjamin's Expert Office, 50 Astor House, N. Y.

For the best Stave, Barrel, Keg, and Hogshead Machinery, address H. A. Crossley, Cleveland, Ohio.

National Steel Tube Cleaner for boiler tubes. Adjustable, durable. Chalmers-Spence Co., 40 John St., N. Y.

For Mill Mach'y & Mill Furnishing, see illus. adv. p. 349.

The Brown Automatic Cut-off Engine; unexcelled for workmanship, economy, and durability. Write for information. C. H. Brown & Co., Fitchburg, Mass.

Gun Powder Pile Drivers. Thos. Shaw, 915 Ridge Avenue, Philadelphia, Pa.

Light and Fine Machinery to order. Foot Lathe catalogue for stamp. Chase & Woodman, Newark, N. J.

For Separators, Farm & Vertical Engines, see adv. p. 349.

For Patent Shapers and Planers, see ills. adv. p. 349.

Best Oak Tanned Leather Belting. Wm. F. Forepaugh, Jr., & Bros., 531 Jefferson St., Philadelphia, Pa.

Stave, Barrel, Keg, and Hogshead Machinery a specialty, by E. & B. Holmes, Buffalo, N. Y.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

C. B. Rogers & Co., Norwich, Conn., Wood Working Machinery of every kind. See adv., page 348.

National Institute of Steam and Mechanical Engineering, Bridgeport, Conn. Blast Furnace Construction and Management. The metallurgy of iron and steel. Practical Instruction in Steam Engineering, and a good situation when competent. Send for pamphlet.

Peck's Patent Drop Press. See adv., page 333.

Reed's Sectional Covering for steam surfaces; any one can apply it; can be removed and replaced without injury. J. A. Locke, Agt., 32 Cortlandt St., N. Y.

Downer's Cleaning and Polishing Oil for bright metals, is the oldest and best in the market. Highly recommended by the New York, Boston, and other Fire Departments throughout the country. For quickness of cleaning and luster produced it has no equal. Sample five gallon can be sent C. O. D. for $3. A. H. Downer, 17 Peck Slip, New York.

Blake "Lion and Eagle" Imp'd Crusher. See p. 333.

Presses, Dies, and Tools for working Sheet Metal, etc. Fruit & other can tools. Bliss & Williams, B'klyn, N. Y.

For Pat. Safety Elevators, Hoisting Engines, Friction Clutch Pulleys, Cut-off Coupling, see Frisbie's ad. p. 349.

Nickel Plating.—Sole manufacturers cast nickel anodes, pure nickel salts, importers Vienna lime, crocus, etc. Condit, Hanson & Van Winkle, Newark, N. J., and 92 and 94 Liberty St., New York.

Sheet Metal Presses, Ferracute Co., Bridgeton, N. J.

Wright's Patent Steam Engine, with automatic cut off. The best engine made. For prices, address William Wright, Manufacturer, Newburgh, N. Y.

Saw-Mill Machinery. Stearns Mfg. Co. See p. 333.

Portable Railroads. Sugar Mills. Horizontal & Beam Steam Engines. Atlantic Steam Engine W'ks, B'klyn, N.Y.

Apply to J. H. Blaisdell for all kinds of Wood and Iron Working Machinery. 107 Liberty St., New York. Send for illustrated catalogue.

The Chester Steel Castings Co., office 407 Library St., Philadelphia, Pa., can prove by 15,000 Crank Shafts, and 10,000 Gear Wheels, now in use, the superiority of their Castings over all others. Circular and price list free.

The Improved Hydraulic Jacks, Punches, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

For Superior Steam Heat. Appar., see adv., page 364.

Gear Wheels for Models (list free); experimental and model work, dies and punches, metal cutting, manufacturing, etc. D. Gilbert & Son, 212 Chester St., Phila., Pa.

The best Truss ever used. Send for descriptive circular to N. Y. Elastic Truss Co., 683 Broadway, New York.

Houston's Four-Sided Moulder. See adv., page 366.

A profitable business for a person with a small capital. Buy a Stereopticon or Magic Lantern, and an interesting assortment of views. Travel, and give public exhibitions. For particulars, send stamp for 116 page catalogue, to McAllister, Mfg Optician, 49 Nassau St., N. Y.

New Economizer Portable Engine. See illus. adv. p. 366.

Rollstone Mac. Co.'s Wood Working Mach'y ad. p. 366.

For Shafts, Pulleys, or Hangers, call and see stock kept at 79 Liberty St., N. Y. Wm. Sellers & Co.

Wm. Sellers & Co., Phila., have introduced a new injector, worked by a single motion of a lever.

Ore Breaker, Crusher, and Pulverizer. Smaller sizes run by horse power. See p. 365. Totten & Co., Pittsburg.

Vacuum Cylinder Oils. See adv., page 365.

Machine Knives for Wood-working Machinery, Book Binders, and Paper Mills. Also manufacturers of Soloman's Parallel Vise, Taylor Stiles & Co., Riegelsville, N.J.

H. A. Lee's Moulding Machines, Worcester, Mass.

Comb'd Punch & Shears; Universal Lathe Chucks. Lambertville Iron Works, Lambertville, N. J. See ad. p. 285.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

(1) A. R. writes: I wish to make an electro-magnet capable of sustaining from 100 pounds to 125 pounds weight. A. To form the core bend a piece of soft, round iron, one inch in diameter and two feet long, into the form of the letter U; on each of its arms slip a spool or coil of insulated wire, three inches in diameter and about eight inches long, formed by winding No. 16 copper wire, cotton insulation, on a mandrel or shaft of round iron, one inch in diameter and one foot long, wrapped with four layers of foolscap paper. As each layer of insulated wire is wound on the mandrel it should be brushed over with hot glue, and when the spool is thus wound, and the glue between each layer of wire is thoroughly dry, then the mandrel is knocked out of the spool. Wind each spool in the same direction, and when the spools are slipped on the core, connect the inside end of one spool of wire with the inside end of the other spool of wire; this will leave two ends of wire, which are to be connected with the poles of a battery of six Bunsen cells.

(2) H. asks: How can nickel be stripped from a piece of Britannia ware without injuring the surface of the latter? A. Nickel cannot readily be stripped from such an alloy cleanly. You may try a bath composed of a strong hot solution of an alkaline nitrate acidified with oil of vitriol. Dip, and rinse well in water; repeat if necessary.

(3) M. C. asks: What is the best steel for magnets? A. That will depend somewhat on the style of magnet that is to be made. For permanent horseshoe magnets, the German spring steel is generally preferred. 2. To what degree should it be tempered? A. Leave it hard, especially at the ends.

(4) E. B. S. asks: How can I put up a sand battery? A. Make a water-tight box of about 1 cubic foot capacity, out of sheet lead one-sixteenth of an inch thick, and nearly fill it with clean white sand moistened with a solution of sulphate of copper. The lead box forms the positive pole of the battery, and a plate of zinc buried in the sand forms the negative pole.

(5) C. B. W. asks: 1. What should be the focal length of a 2½ inch objective for an astronomical telescope? A. From 36 to 44 inches. 2. How can I construct an astronomical eyepiece? A. See SUPPLEMENT, No. 252, for full instructions for constructing small telescopes.

(6) W. R. A. asks: How can I refill the porous cells of a Leclanche battery? A. Hold the top of the porous cup in a gas flame until the pitch with which it is sealed is softened, then draw out the carbon plate, and refill the cup with granulated black oxide of manganese and coarsely powdered gas coke, in about the proportion of five parts of the oxide of manganese to one of gas coke.

(7) McK. & Co. ask (1) how to make a waterproof paste to stick silk on silk. A. Macerate virgin rubber (caoutchouc) cut into finest shavings with about ten times its weight of pure benzole in an open-mouthed bottle set in hot water (away from fire; shake occasionally and add more benzole, if necessary, until a perfect solution is obtained. The cement should not be used in excess—in such quantity as to delay its drying. 2. Where can I buy diamond cutting tools and machinery? Where can I get a young man as jeweler and diamond cutter and setter? A. An advertisement in Business and Personal column would no doubt procure the information you require.

(8) W. E. H. asks: Can you describe a simple inexpensive way to prepare oxygen for inhalation? Also plan for inhaling instrument such as may be made by any handy workman? If so, you may enable many rural physicians to test the efficacy of oxygen in catarrh and in pulmonary affections. A. Mix pure crystallized potassium chlorate with about one-quarter its weight of pure black oxide of manganese, and heat the mixture in a copper retort, with large delivery tube, until the gas begins to come over. Conduct the gas through a large empty bottle (to avoid accident by back pressure), then through a strong solution of iron sulphate (copperas), and then through an iron tube several feet in length, filled loosely with fresh quicklime in granular lumps (free from dust). Collect in a rubber bag. An ordinary mouth piece answers well enough if the air from the lungs is expelled through the nostrils, or so as not to contaminate the contents of the bag. The heat should be continued under the retort with caution to avoid too rapid a disengagement of the oxygen until no more gas comes over.

(9) C. H. C. asks: Does the area of the base or bottom of a cistern have anything to do with the pressure of the contents on the sides of the same, or, in other words, does not the pressure on the sides of a cistern depend entirely on the depth of the contents and not on the cubical contents of the same? A. The pressure per square foot depends entirely on the depth of the water.

(10) C. W. Y. writes: We have a quantity of silver and of gold solution, made the usual way with cyanide of potassium. 1. Is there a cheap way of precipitating the metals so that we can use them? A. Precipitate the silver solution with excess of caustic soda or carbonate of soda; wash, dry, and heat the silver cyanide mixed with borax glass nearly to whiteness in a small blacklead crucible. Make the gold bath distinctly acid by adding sulphuric acid (out of doors to avoid inhaling the poisonous gas given off), then add an excess of sulphate of iron in strong aqueous solution to precipitate the gold. Collect the precipitate gold on a filter, wash with hot water, and fuse in a small crucible with borax glass as in the case of silver. 2. Is there some way that we can prepare the solution to apply with a sponge like the ordinary washes for cheap plating? A. We know of no way of using the bath as suggested. 3. How can we make a cheap battery so as to use our solution, provided it cannot be precipitated without too much expense? The solution is so rich that any bright clean metal will be plated over in a few minutes. A. See Nos. 157, 158, and 159, SCIENTIFIC AMERICAN SUPPLEMENT, for descriptions of batteries.

(11) C. U. F. asks for the best preparation of whitewash that will stand the storms and time (for outside of buildings). A. For brickwork exposed to damp take one half peck well burned quicklime, fresh from the kiln, slake with hot water, enough to reduce it to a paste, and pass it through a fine sieve; add a gallon of clean white salt which has been dissolved in a small quantity of boiling water, and a thin smooth paste, also hot, made from 1 lb. fine rice flour; also ¼ lb. best white glue, made in the water bath. Mix together, stir well, add ¼ lb. best Spanish whiting in 5 quarts boiling water, stir, cover over to retain heat and exclude dust, and let it stand a week. Heat to boiling, stir, and apply hot. The above proportions will cover 40 square yards. 2. Also the best way to refine cider for family use? A. See pp. 394 (7) and (15), Vol. 39, and 299 (24) and 28 (46), Vol. 38, SCIENTIFIC AMERICAN.

(12) J. W. McF. asks: 1. Of what is the wax composed that is used by electro-platers for building up card stands, etc., when the top has an uneven edge, so that when gold plating the inside, the solution will cover the whole surface? A. Resin, 3 oz.; beeswax, 2 oz.; sweetoil, q. s. to soften. Heat together in a small dish, stir with a stick, pour into cold water, and work it well with the hands. Should it get brittle more oil must be incorporated. 2. I have a scarf pin that is made of oxidized silver. Can you inform me how it is done? A. Dip the clean silver into aqueous solution of an alkaline sulphide, or expose it while moist to the action of sulphureted hydrogen.

(13) G. A. L. asks: How can the mottled coating seen on new gun barrels be reproduced, or what ingredients are required to make a preparation suitable for browning them, and which will be harmless to the iron? A. 1. Mix powdered chloride of antimony into a thin creamy paste with olive oil, adding a few drops of nitric acid. Warm the metal, cover its surface uniformly with this paste, and let it stand until properly browned. 2. Nitric acid, ½ oz.; spirit of niter, ½ oz.; spirit of wine, 1 oz.; sulphate of copper, 2 oz.; tincture chloride of iron, 1 oz.; water, 40 oz. 3. Sulphate of copper, 1 oz; water, 20 oz; spirit of niter, 1 oz. The blue vitriol is dissolved in the hot water, and the solution cooled before the other ingredients are added. The burnishing and marking is effected with the burnisher and scratch brush, the polishing with a piece of smooth hard wood. Lacquer with thin alcoholic shellac and use the wood polisher again. The metal in the first place must be chemically clean.

(14) A. C. L. asks: Will you please inform me what kind of cement is used in cementing rubber rolls as used in clothes wringers, and how applied? A. See answer to McK & Co. on this page.

(15) A. F. B. asks: Can you give me a formula for a composition that will serve as a substitute for vulcanized rubber? I wish to make some dishes for photographic purposes. A. You can use wooden or papier mache vessels coated with a film of gutta percha dissolved in warm benzole. We know of no satisfactory substitute for rubber.

(16) J. H. T. writes: It is claimed that fruit or vegetables of any kind if heated and put into air tight jars or cans will keep without working or spoiling, but I find that green corn is an exception; if there be other exceptions I do not know of them. Can you tell me why green corn is an exception? Also how it is that it ferments when sealed up in airtight cans? I am told that if I put two ounces tartaric acid to every sixteen quarts of corn while cooking and then seal it up it will keep and not ferment. Why is it so? A. The secret lies in thoroughly curing the corn—it requires much longer heating than most vegetables. The natural milk is not removed and tartaric acid is not used. Pack each can as full as possible, seal, and place at once in the boiling water; after it has boiled long enough tap a low hole, and as soon as the air and steam are out seal again with a drop of solder.

(17) "Cavalry Man" asks: Can you give in your paper a receipt for putting a dark blue color to steel? The arms we use are of a dark blue color when we first receive them, but this soon wears off, and I would like to know some method of restoring it. It is only a surface coat, and muriatic acid washes it off so that if you try to impart a blue with muriatic acid it first washes off the color already on and thus necessitates bluing the whole barrel instead of only the spot devoid of color. A. The original color is due to the film of oxide formed on tempering the metal. It cannot well be repaired when injured without reheating the whole piece. A good, though easily injured imitation, for cloaking a worn spot is a very thin alcoholic solution of shellac, colored to suit with a trace of aniline blue—purple.

(18) W. E. J. asks: 1. Will two currents, one positive and one negative, traveling over the same wire and in the same direction, neutralize each other? A. Yes. 2. Is there any way by which two magnets may be arranged so as to be acted on independently over one wire? A. Yes. See Duplex and Quadruplex Telegraphy in "Prescott's Electricity and the Electric Telegraph."

(19) S. B. M. asks (1) how to make impression paper different colors. A. We refer you to SCIENTIFIC AMERICAN, Vol. 40, page 187 (22). 2. How to ebonize wood. A. See SCIENTIFIC AMERICAN, Vol. 40, page 91 (18). 3. The proper position of eccentric from the crank pin on an engine. A. It should be set ahead of the crank pin; but how much will depend upon the valve and valve gear; it should be sufficient to give one-sixteenth to three-sixteenth inch opening of valve when the crank pin is on the center, depending upon the rise and velocity of the piston.

(20) G. H. E. asks: 1. Do polarized armatures lose their magnetism soon? A. With fair usage, no. 2. Is their use to be commended as to practical efficiency? A. Yes; they are largely used in telegraphy and in telephone calls.

(21) C. W. B. asks: 1. Which is better for the drive wheel of a foot power scroll saw, an iron or wooden wheel? A. Iron is best, but wood answers a good purpose. 2. Is it better to have a tight balance wheel on the shaft that drives the saw? A. Yes.

(22) A. L. E. asks how to find the circumference of a circle, the diameter being given. A. Multiply the diameter by 3.1416.

(23) G. B. C. asks (1) for an amateur telegraph line, one-half mile in length, five stations: what size of wire? A. No. 2 galvanized iron wire will answer. 2. How many Leclanche cells? A. Five to each station. 3. How much and what size of insulated wire on each pair of spools of sounders. A. Use 8 or 10 layers of No. 24 silk covered copper wire, taking care to have nearly the same amount of wire in each magnet.

(24) G. H. asks how to blue wire such as used in manufacturing hair pins, also fish hooks, etc. A. Dip them in a lacquer composed of a good quality of alcoholic shellac varnish to which has been added a little aniline blue.

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(25) J. W. H. asks: Will a saw that is run by water power run any stronger at night than in the day? A. No. 2. Will pure steam from the upper part of a steam boiler when let out scald, if no water comes with the steam? A. If of sufficiently high pressure it will not scald near the outlet.

(26) H. R. asks: How are Bourdon springs for pressure gauges manufactured? A. The tube is, we believe, first drawn with a cylindrical section, like other drawn brass tubes, then given the proper section by either rollers or drawing through another die.

(27) W. S. asks: 1. How can I melt copper, brass, and zinc, and what kind of furnace and heat will I need if I melt copper and zinc together to make brass? How many parts must I have and what kind of flux, or is there any need of flux? For melting, will I have to take an iron ladle or crucible? A. You can melt the metals referred to in a common coal fire. You will require a crucible for copper and brass, but zinc may be melted in an iron ladle, Common brass is composed of copper 3 parts, zinc 1 part. Fine yellow brass, copper 2 parts, zinc 1 part. Melt the copper, then add the zinc Stir the alloy with a dry wooden rod. A little borax may be used as a flux. 2. On making moulds, what kind of mixture must I take to work nicely and cast well? A. Fine moulding sand is the best for general use.

(28) W. T. K. asks (1) how to connect three steam whistles so that they will all go off at once? A. Have one common steam valve to the 3 whistles. 2. What power is in a cylinder 1⅛ inch bore and 1¾ stroke, at 600 revolutions a minute? A. For rules for calculating horse power of engines, see SUPPLEMENT, No. 253.

(29) J. K. asks: 1. What will prevent a grindstone wearing off in one place more than in another? I have one about 30 inches in diameter, and there is one place that is soft in it and I can't keep it round. A. It is an inherent defect in the stone. We know of no remedy. 2. What power am I using. The pulley I get my power from is 14 inches in diameter, and it makes 250 revolutions per minute with a 2-inch belt. A. About 2¼ horse power; possibly 2½, if the belt is run very tight.

(30) D. C. M. asks: 1. How can I measure the power of a telescope or field glass? A. The magnifying power of a telescope is found by dividing the focal length of the objective by the focal length of the eyepiece. 2. How should I proceed to make a sunglass for a telescope? A. Place a piece of very dark glass over the eyepiece. See SUPPLEMENT 252 for directions for making telescopes. 3. Which is the best for an observatory, a mercurial or an aneroid barometer? A. Mercurial. 4. Where can I procure dynamite cartridges for extracting stumps, and what will be the probable cost? A. Address manufacturers who advertise in our columns. 5. Where can I get a copy of the "Nautical Almanac?" A. From industrial publishers whose advertisements may be found in another column. 6. Who shall I apply to to become a volunteer observer for the U. S. Signal Service? A. Apply to the chief of the Signal Service Bureau at Washington, D. C.

(31) K. E. B. asks: 1. Could I obtain power enough from a ½ inch hydrant to run an electric machine five times the size of the cut on first page of SUPPLEMENT, No. 161? Water has good pressure from Worthington engines. A. It depends entirely on the pressure and the size of the pipe leading to the half inch aperture. With a pressure of 40 pounds per square inch you could do it. If you intend making a machine of the size named you should follow Siemens' latest machine, or imitate some of the more recent machines of prominent makers. 2. How does electricity pass from the cores of the magnets to the wire, the wire being insulated on an electric machine? A. It does not pass from the cores of the magnets to the wires. It is evident you do not understand the principle upon which the dynamo-electric machine operates. You should consult some elementary work on physics. 3. Why must the machine given in No. 161 SUPPLEMENT be set on a brass plate? I see other machines rest on iron or wood. A. Any non-magnetic material will do. Iron cannot be used, as it would close the poles of the magnet. 4. Suppose an electric machine will run ten lamps, and I only use one, will my light be any larger from the one than it would when all ten were in use? A. Yes. 5. I understand that electricity does not burn passing through the carbons of a lamp. If so, why should the number of lamps to a machine have a limit? A. Every lamp adds to the resistance of the circuit, and there is a limit to the resistance the machine is capable of overcoming.

(32) J. N. W. asks: Do any of the stars twinkle except the fixed stars? A. All stars twinkle. This phenomenon is due to the constantly varying density of the atmosphere.

(33) R. M. asks how steel watch chains and other small steel articles are polished. A. By tumbling in a wooden cylinder containing leather scraps and crocus.

(34) C. A.C. asks: 1. How many feet of No. 16 and No. 36 copper wire are required to produce one ohm resistance? A. Of No. 16, American gauge, about 232 feet. Of No. 36, about 2½ feet. 2. What weight ought an electro-magnet to lift if composed of two spools with cores 1 x 3 inches, wrapped with twelve layers of No. 16 cotton-covered copper wire, with ten cells of gravity battery? A. It ought to lift 50 pounds or more. You would get a better effect by making the cores much longer, say 8 inches, and winding the same amount of wire so as to form a coil 5 inches long on the outer end of each core.

(35) J. A. asks: 1. Will you please answer in your next issue of the SCIENTIFIC AMERICAN how can water backs which are full of lime be cleared out? A. There is no practical means, except mechanical means, chipping or the like, that can be of any service. 2. Is any essential part of the locomotive patented? A. Many of the modern appliances to locomotives are patented, but the main parts of the locomotive are old, and may be made without infringing patents.

(36) P. C. N., C. G., W. V., C. W. T., and others ask: 1. For a plain description of how to proceed in order to charge a straight bar of steel with sufficient magnetism to give it the power of lifting four times its own weight. Also, how to proceed with horse-shoe and other forms. 2. The name of the best brand of steel to use (Jessup's, chrome, or black diamond), and why it is the best. How to temper. 3. Is there any gain in allowing the bar to remain under the influence of the current for a long time, or does it receive the full charge instantaneously? In fact, we would like some information on this subject that we can rely upon. A. 1. The quickest and best way to magnetize steel bars is to place them centrally in a suitable coil, and then connect the helix with the wires from a dynamo-electric machine or powerful battery for a few seconds, remembering to break the current before removing the magnet from the coil. If the source of the current is a dynamo machine, the coil should be about 2½ inches long and should consist of 10 or 12 layers of No. 12 magnet wire. If a battery is used, a coil 1½ inches long, composed of 14 or 16 layers of No. 16 magnet wire, will be the best. The internal diameter of the coil should be only large enough to admit the bars easily. A battery of six Grenet elements, each having an effective zinc surface of 30 square inches connected in series, will do the work very well on small magnets; such, for instance, as are used in telephones. Where a number of magnets are to be made at one time the bars may be passed in a continuous line through the coil, always keeping three bars in contact end to end, adding one above the coil before taking one off below. In this manner sixty bar magnets have been strongly charged in ten minutes. Horse-shoe magnets cannot be charged so readily. There are two or three ways of charging them. One way is to place them in contact with the poles of a very strong electro-magnet, removing them after breaking the current; another method is to place each limb of the magnet in a coil adapted to the current to be used, and still another method is to employ a single coil, inserting one pole of the magnet into the coil in one direction, thus breaking the current, and inserting the other pole into the coil from the opposite direction. It is well to remember that the magnet will be very much impaired if the current is not broken before removing it from the coil. The secret of success in charging magnets is to have a strong current. It is impossible to make magnets satisfactorily without this all-important requisite. 2. As to the quality of steel best adapted to this purpose, machinery steel hardened and not tempered answers admirably. For horse-shoe magnets German spring steel is the best. Tool steel answers well if hardened and drawn to a straw color. 3. The steel receives its maximum charge almost instantly. It is useless to allow it to remain under the influence of the magnetizing current more than a few seconds.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

A. D. L.—A fair variety of potter's clay.—P. M. C.—An argillaceous lime carbonate.—W. T.—The clay contains a large percentage of alkalies and a little lime phosphate.—C. McG.—It is tourmaline.—H. S.—Zinc sulphide.—G. C. R—A fair quality of potter's clay.—J. T C.—Carbonate of lime. Some of the stone would probably make a fair cement.—F. D. H.—Tourmaline.—G. N. H.—Titaniferous iron oxide.

COMMUNICATIONS RECEIVED.

On Swift's Comet. By W. R. B.
Features of No. 9. By W. B. W.
On Scientific Discussion. By C. R.

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INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

November 9, 1880,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A printed copy of the specification and drawing of any patent in the annexed list, also of any patent issued since 1866, will be furnished from this office for one dollar. In ordering please state the number and date of the patent desired and remit to Munn & Co., 37 Park Row, New York city. We also furnish copies of patents granted prior to 1866; but at increased cost, as the specifications not being printed, must be copied by hand.

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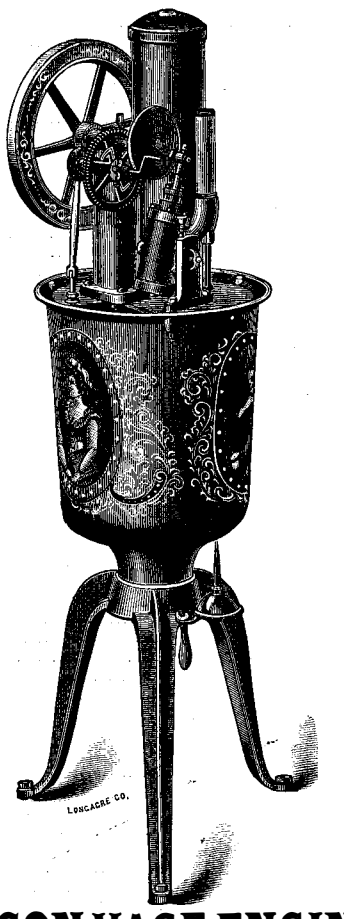

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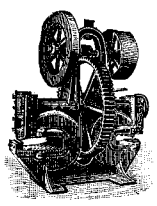

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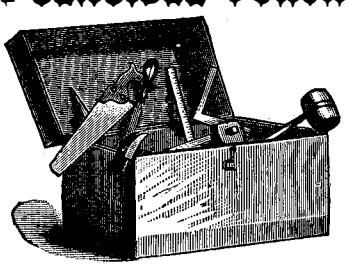

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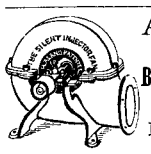

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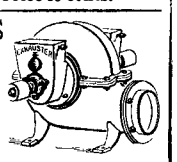

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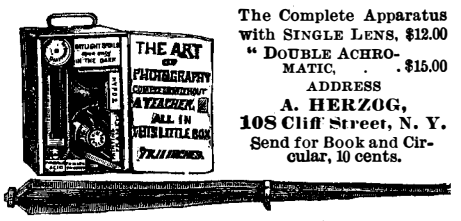

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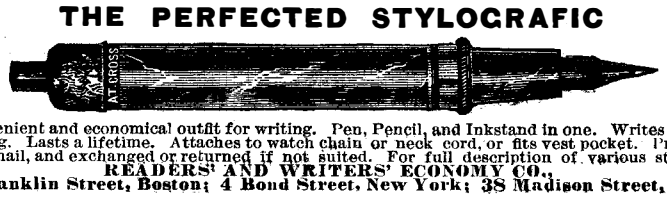
LITTLE  **GIANT.**

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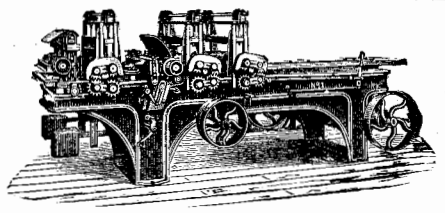

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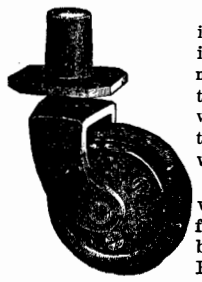

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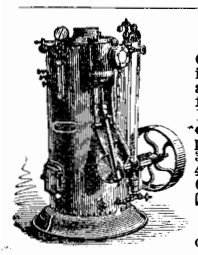

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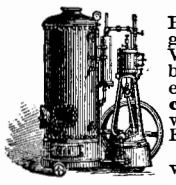

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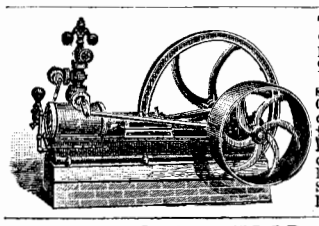

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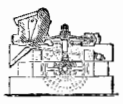

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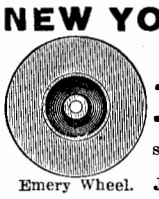

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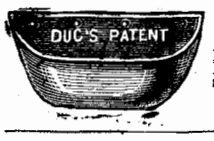

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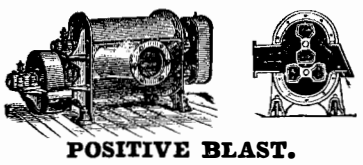

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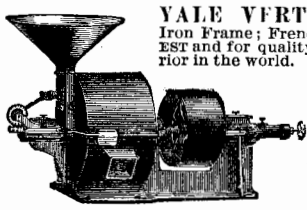

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POST OFFICE DEPARTMENT,
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As the public exposure and searching examination necessary to intelligent bidding on any prescribed model of a lock and key would tend to impair, if not entirely destroy, the further utility of such locks and keys for the purposes of the mails, the Postmaster General prescribes no model or sample for bidders, but relies for a selection on the mechanical skill and ingenuity which a fair competition among inventors, hereby invited, may develop in samples submitted by them.

Specifications of the conditions and requirements relating to proposals, samples, contract, etc., as well as forms of proposal, will be furnished on application by letter to the Second Assistant Postmaster General.

No proposal will be considered unless it shall have been submitted in accordance with such specification and forms.

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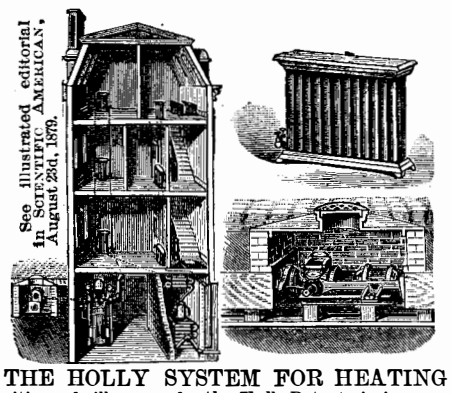
JAS. N. TYNER,
Acting Postmaster General.



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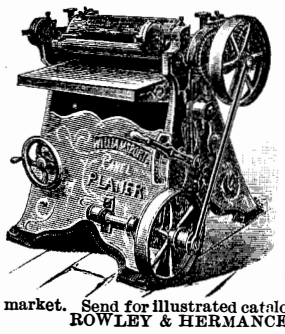

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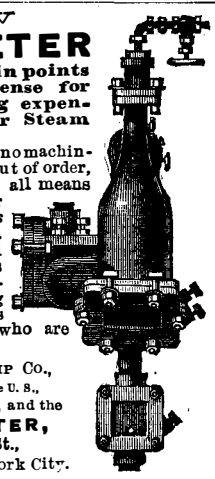

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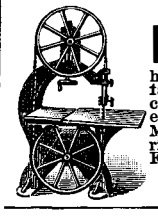

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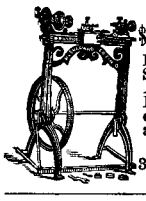

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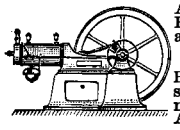
On returning to England, I have arranged with **Mr. James L. Howard, of Hartford, Conn.,** to represent the interests of **The Perkins' Engine Company, Limited, of London,** in this country. All communications addressed to him on this subject will receive attention.
GEO. DEANE, Secretary,
THE PERKINS' ENGINE CO., LIMITED.



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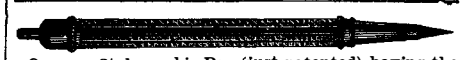

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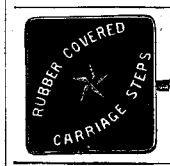

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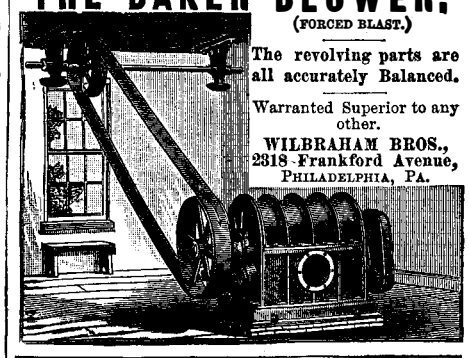

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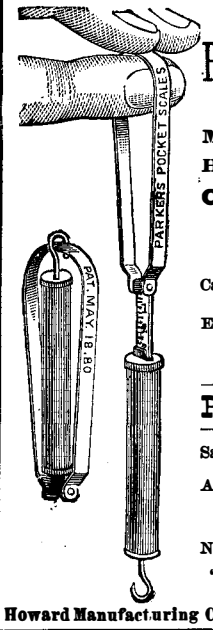

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